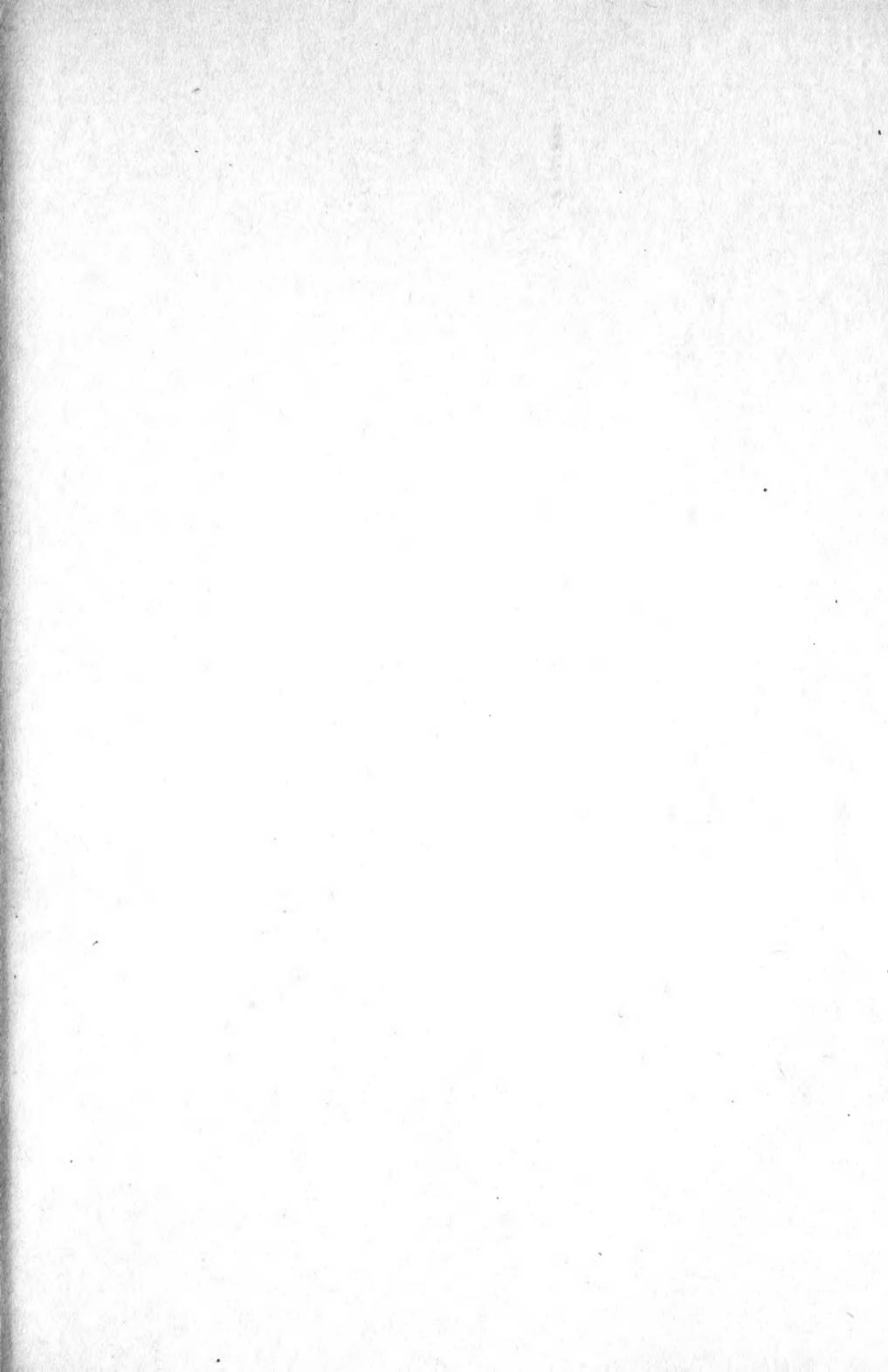
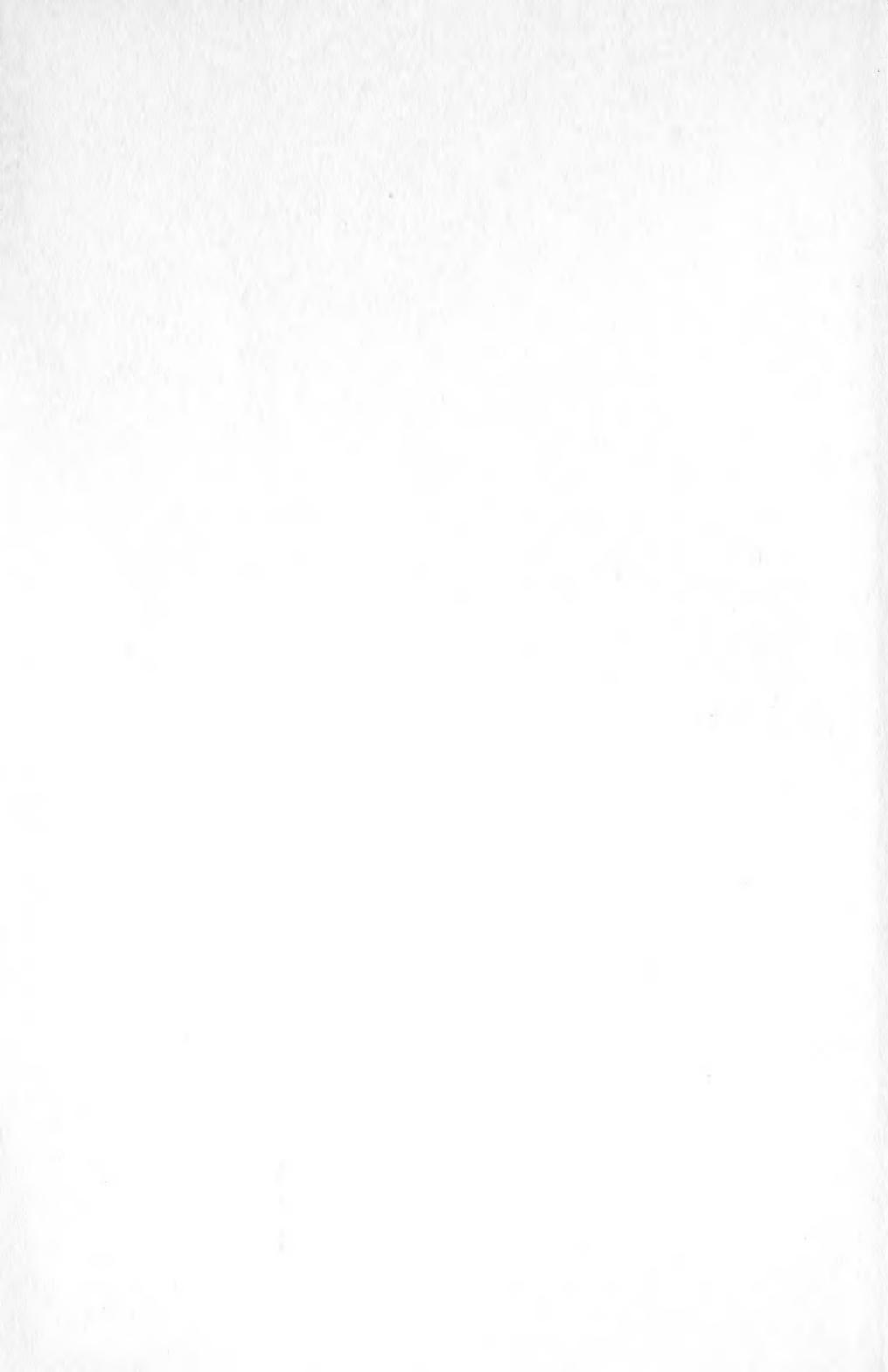


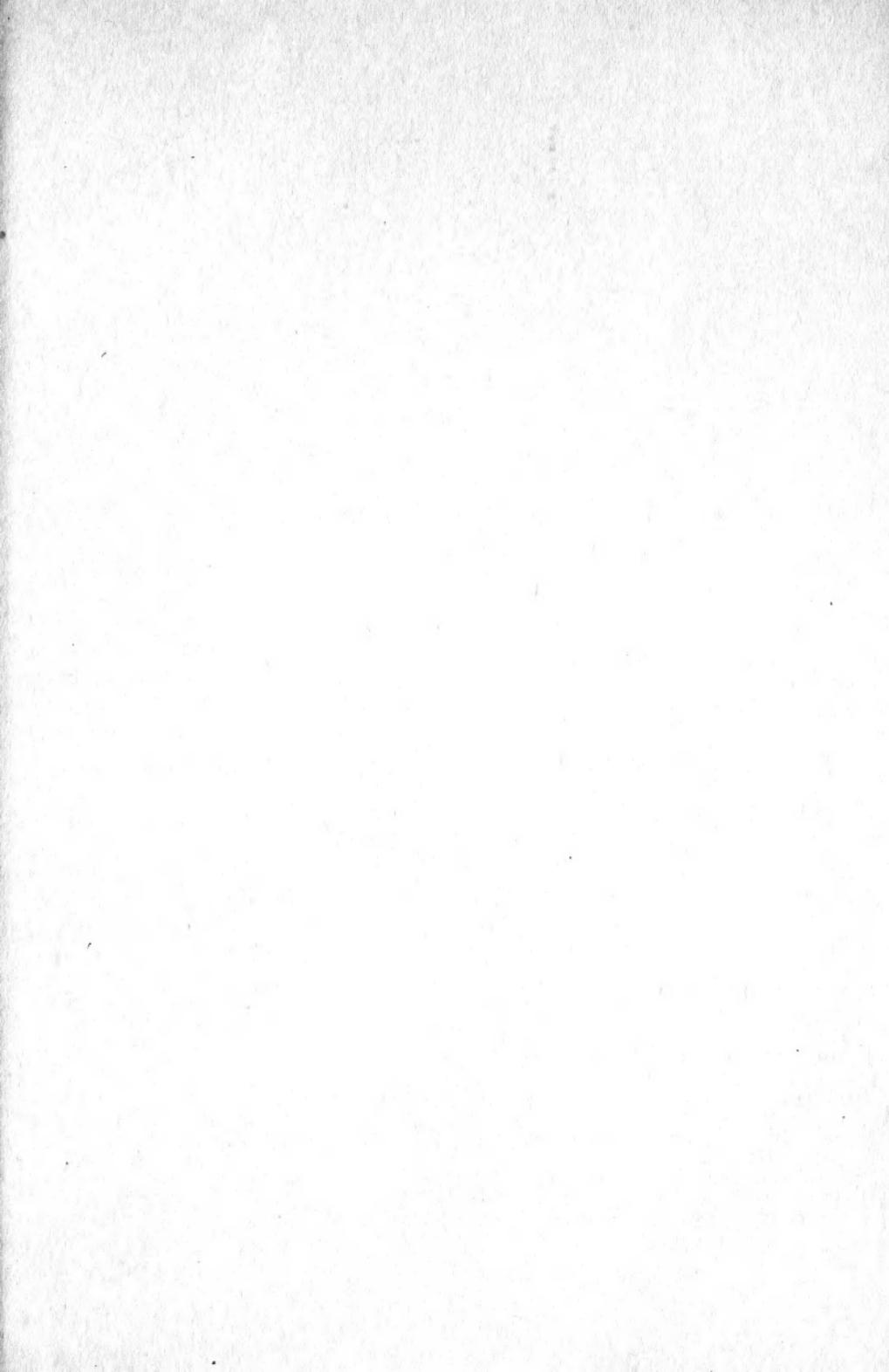


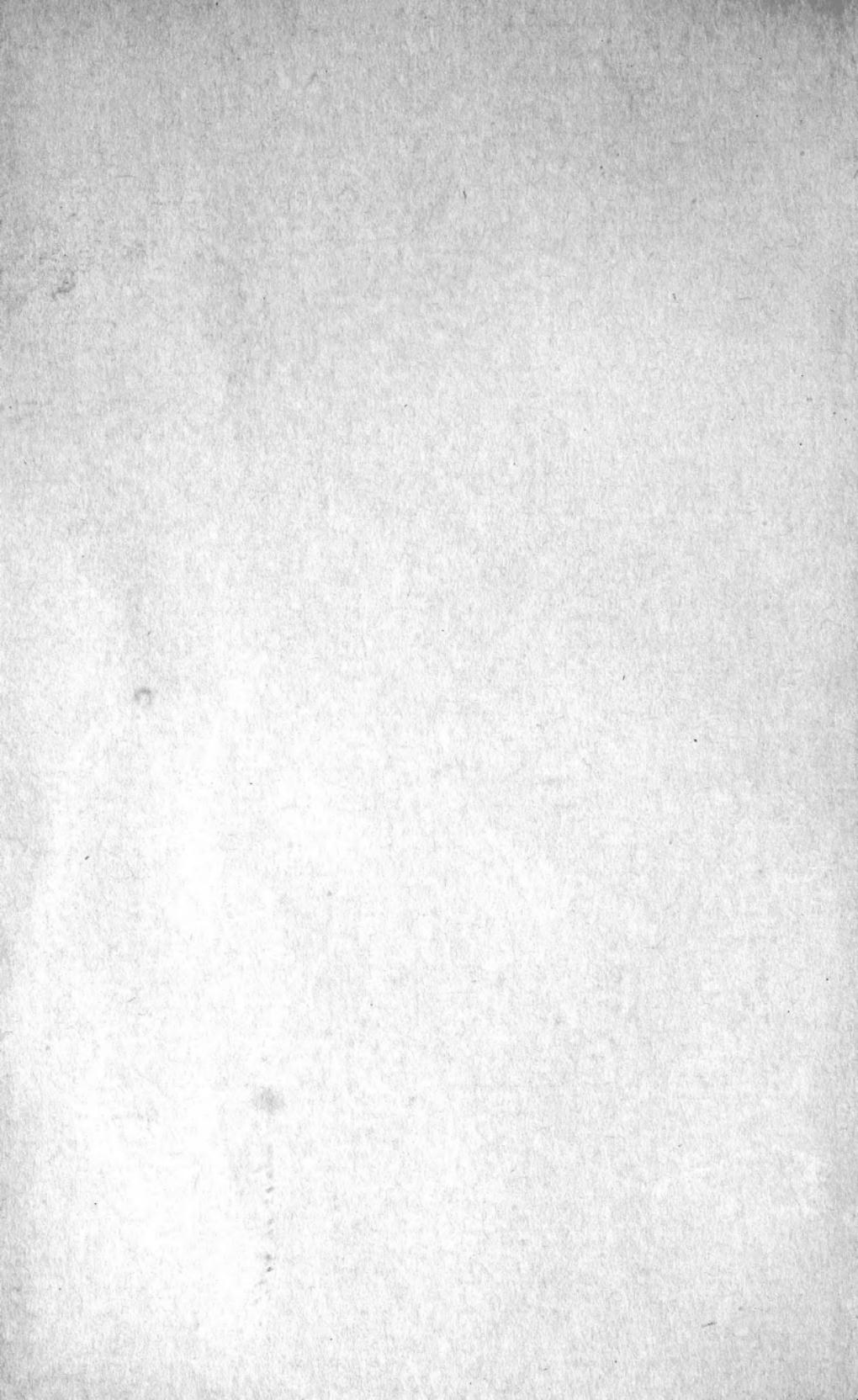
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THIRD DISSERTATION

ON

QUICK-LIME

AND

LIME-WATER.

By CHARLES ALSTON, M. D.

The King's Botanist in SCOTLAND, Fellow of the Royal College of PHYSICIANS, and Professor of Medicine and Botany in the University of EDINBURGH.



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M D C C L V I I .

P R E F A C E.

THE following Discourse was finished in *October*, and would have been then published, had I not received imperfect Accounts of the Success of Lime-water in some more Cases, especially arthritic: And being now sufficiently informed of the Circumstances, I shall here give two or three more pretty remarkable Cases, to be added to the eleven in the Dissertation.

Case 12. A Gentleman of a sound Constitution, and healthy, till about forty Years old, became then subject to the Gravel in the Kidneys; and having laboured under it for one Year, was also seized with the Gout; both which Diseases he seemed to have derived from his Father, who suffered much by them. This, as well as the excessive Pain, made him very apprehensive and abstemious, and readily follow all the Directions given him; but all to no Purpose. At length, after having for a long Time passed Blood with his Urine, which the smallest Motion increased, and suffered excessive Pain, a large Stone came away, as did several others afterward, with less Trouble. The Gout began in the first Joint of his big Toe, accompanied with the usual Symptoms, every Paroxysm almost increasing in Strength; until, by these Diseases, and living almost entirely on Bread and Water for about five Years, he became very weak, being reduced to Skin and Bones; when his Doctor, who was also troubled with the Gravel, having seen one of the Dissertations on Quick-lime and Lime-water, and given it his Patient to read, both determined to have Recourse to this Liquor. The Patient, having a Fit of the Gout on him at the Time, began immediately to drink it, taking two or three Gills Morning and Evening; the Effect whereof, he says, was really miraculous. For notwithstanding his accurate Diet, and the Ease and Warmth wherewith he indulged his

Feet, the Pain, Inflammation, and Swelling, affected them to above his Ancles. But he had not drank the Lime-water for two Days, when the Pain sensibly abated by Degrees, and with it the Inflammation and Swelling ; leaving first the Ancles, then the Parts below, and so gradually descending, till, in a few Days Time, all the Symptoms of the Gout were driven, as he expresses it, out at the Point of his big Toes, by the Lime-water. Besides the Gravel and Gout, before he drank the Lime-water, the least Motion gave him a great Difficulty of breathing, and Palpitation at his Heart : He had no Appetite for Meat, and a very bad Digestion ; every thing turning sour in his Stomach, though he never tasted any fermented Liquor. He was also troubled with the Scurvy. But the Lime-water has freed him of them all. He can take a Glass of Wine freely, and has a good Appetite, as well as Digestion. He does not continue the Use of Lime-water when in good Health ; but whenever he becomes any way uneasy or apprehensive, he has immediate Recourse to his favourite Lime-water, which soon restores him to perfect Soundness. Thus, about eighteen Months ago, he was attacked with a Giddiness and Heaviness of the Head, or a slight Vertigo ; which the Lime-water soon removed. To prevent Costiveness, when he drinks Lime-water, he commonly dissolves in it some *Spanish Sope*. In a Word, notwithstanding such a Complication of Diseases, he is now at fifty Years of Age, a lusty vigorous Man, and eats and sleeps as well as ever. He tells me he has now commenced Doctor himself, and cured many ; and particularly a Neighbour of his ; who, complaining of the Gout, and of the Loss it was to him in his Business, told him he would cure him for Twopence, and was better than his Word. This *Cafe* I had from the Gentleman's own Mouth, the 5th of December 1757.

Cafe 13. A Gentleman of a clean and spare, rather than plump Habit of Body, and commonly very temperate, though now and then taking a cheering Glass ; after a long State of great Health, in October 1747, being

being about sixty Years old, was surprised one Evening with a violent Pain in one of his Feet, which he soon found to be the Gout, which confined him no less than thirteen Weeks. He then gave over drinking all spirituous Liquors, except Claret, and had not another Fit till *July 1750*, which continued but six Weeks. After three or four more such painful and long Paroxysms, (out of which he always recovered slowly), the last whereof began in *March 1757*, confined him for two Months, and left him excessively weak, he determined to lay aside his Claret, and make Trial of Lime-water, hoping thereby sooner to recover his Stomach and Strength. He began to drink it the 15th of *August*, taking half an *English Pint* twice a-day; and its Success has exceeded his Hopes: For he has recovered his Strength much sooner after this, than after any former Fit; he eats and sleeps well; and, which he takes particular Notice of, he has not known what it is to be thirsty ever since he drank the Lime-water, though he was made believe that it would increase Thirst. Which calls to mind what a learned Physician, of great Practice in the Country, wrote to me in *May 1756*; who, among other Things, says, "I have now experienced Lime-water to be the most effectual quenching, refreshing, and composing Drink, in Fevers." Yea, in my own Experience, as well as that of others, I have found it more cooling and quenching by far than common Water. And to conclude, our arthritic Gentleman finds so much Benefit from the Lime-water, that he is resolved to continue the Use of it, which it is hoped will prevent the Return of any more Paroxysms. It was my complimenting him on his more than ordinary good Looks that procured me this Account of his *Cafe*, *December 16. 1757.*

Cafe 14. A strong and vigorous Gentleman, when about thirty Years old, being engaged in a Match at that violent Exercise called the *long Bullets*, and exerting his utmost Strength to throw beyond his Antagonist, found as it were a Prick in his Stomach, as if he had received

received a Wound by a pointed Instrument. Ever since that Misfortune, which is more than ten Years, he has had a Pain there, and been in a very bad State of Health, having tried various Remedies, and among others the Goat-whey ; but all in vain. In the Beginning of July last he was attacked with a bloody Flux, daily voiding a great deal of Blood ; not liquid, but congealed, as if it had lodged for some time in his Guts. In this State he has continued for near five Months, without Intermission, or any Change to the better. For although the *vitrum ceratum antimonii* bound him up, yet his Stomach swelled, and in two or three Days the Flux violently returned. On the 14th of November last the Minister of the Parish visited him, and finding him greatly emaciated, complaining of Thirst, want of Appetite, &c. and of the melancholy Prospect he had of the Winter, advised him to try Lime-water, taking at first half an *English* Pint in the Morning, and as much any Time of the Day he inclined, assuring him that it could do no harm. " He followed my Advice," says the Minister ; " and the Success has exceeded our Expectation ; the Symptoms are all abated ; he has passed very little Blood since the 15th of November, when he began to drink the Lime-water ; he sleeps well, begins to recover his Appetite ; from thirteen is brought to three Stools a day, and is in great Hopes of a perfect Recovery." On December 1. he thought himself quite well, having but one Stool a-day, as when in Health. But imprudently using some too violent Exercise, his Disease recurred, but not with its usual Violence, and was better on the 5th. He resolves to continue the Remedy with more Caution, and expects a complete Cure. Extracted from two Letters from the said Minister, dated Nov. 21. and Dec. 5. 1757.

EDINBURGH, Dec. 20.

1757.

THIRD DISSERTATION

ON

Quick-Lime and Lime-Water.

Lime-water has of late been found so efficacious a Remedy, in the most obstinate Diseases, for which it is recommended in the former Dissertations, that not to make a few of them more generally known, would be an inexcusable Omission. The Credit of a Medicine so easy to be had, and which costs, in a manner, nothing, is difficultly established, and yet more difficultly kept up; People generally rating Things according to their Price; though nothing can be more faulty in Physic. It is certainly the most valuable Remedy which produces the most salutary Effects; and the more common it is, it is so much the better. Thus obliged again to take up the Pen, I must also be allowed to make such Additions as may further illustrate the Subject. I shall therefore, *1mo*, give some Instances of the Success of Lime-water in several stubborn Distempers; *2do*, Explain more fully some Passages in the Dissertations; and, *3rd*, Having made a few Additions, *4to*, do Justice to some Criticisms on these Papers, which have lately come abroad.

1. Of all the Cures performed by Lime-water, which I have either seen, or have been transmitted to me by others, I think those contained in the following Letter, which a learned Physician has favoured me with, deserve the most particular Attention. For however much the Discovery of some of the Virtues of Medicines, may be owing to what is called *Chance*, yet,

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“ By observing,” says the Doctor, “ their Effects in different Diseases and Constitutions, many new Virtues in one and the same Medicine, have often been found out. And since you have found, and communicated to the Public, many of the salutary Virtues of Lime-water ; to you it cannot be disagreeable to mention the following, which have occurred to me. Not that I fancy, or infer from thence, that Lime, or any other Medicine, will be found catholic, or infallible in every similar Case. If it gives Relief but to a few of many Distressed, how valuable such a Remedy, where the Trial is neither hazardous nor expensive ?

2. *Case 1.* “ A Gentleman, now 44 Years old, naturally of an athletic healthy Constitution, which from his Infancy he had used with the greatest Freedom, until of late Years he came to be grievously tormented with violent Pains in the Region of his Stomach and Sides ; which, after repeated Evacuations by bleeding and blistering, shifted from the Sides to the Extremities, and terminated at last in a fixed Gout, for twelve Weeks, and brought him very low. After so long Confinement, he was seized with nephritic Complaints, and flying goutish Pains in his Body. He passed several small Stones and Sand, with a good deal of Pain ; for which he was ordered proper Diet and Exercise, with a Course of Lime-water, which for two Years was his constant Drink, to the Quantity of four or five Pounds Weight in twenty-four Hours. All last Year he was able, and did often ride after the Hounds in full Chace ; and has now recovered Spirits, Strength, and Looks, as good as ever ; with no Complaint of Gout for two Years, or Gravel for twelve Months past : And though lately, for six Weeks, he lived fully, and drank freely, sometimes to Excess ; as yet he has felt no bad Effects of it. The Gentleman himself also observes, that he was much more afflicted with the Scurvy, before he drank the Lime-water, than he is now.

3. *Case 2.* “ Another Gentleman, about 50 Years of Age,

Age, of a robust Habit of Body, was, last Winter and Spring, threatened with a deep Consumption; for which he used Tar-pills in great Quantities, and drank Lime-water from a Bottle to two Bottles a-day. He now finds himself in better Health and Spirits than at any Time for twenty-four Years past, that he was first seized with the Gout. He used to have long and violent Paroxysms, both Autumn and Spring, for fourteen Years successively. He is now free of all goutish Pains and Rheumatism, as well as of every phthisical Symptom, which he had not been for many Years. His Appetite and Digestion are remarkably better.

4. *Case 3.* "Another Gentleman, above 60 Years old, who, from Anxiety in domestic Affairs, had his Mind greatly and frequently disquieted, and often altogether void of Reason; after the last Attack of that kind, was seized with a nephritic Complaint, and passed a small Stone; which occasioned his being put on a Course of Lime-water, with a proper *Regimen*. Since that Time, which is three Years ago, he has been quite well, has recovered his Looks and Flesh, without the least Return of low Spirits, and is as distinct and fit for Business as ever. Having observed, as is often the Case, that when his Head was affected, his Stomach was always loaded with Phlegm, and nothing relieved him so much, as throwing it up by Mustard Vomits; from thence I conjectured, that Lime-water had done him remarkable Service, by preventing so much Phlegm's being generated in the *primæ viæ*; and hoped it might be of Use in the same Complaints, though from different Causes. Nor was I disappointed in my Expectations of Success, in the two following Cases.

5. *Case 4.* "A young Lady, about 30 Years of Age, who had been irregular as to her *Menses* for a long Time, and changing the Exercise and free Air of a Country-life, for a sedentary and confined one in Town, soon complained of Pains affecting her in various and extraordinary Shapes; for which she got a great Va-

riety of nervous, deobstruent, and emmenagogue Medicines, to little Purpose; till at last her Head and Judgment were frequently affected, yea quite disorder'd. About twelve Months ago, in an Attack of that kind, after proper Evacuations, and other Medicines, the Distemper still continuing, I thought that Lime-water might be of Service, on the same account as in the preceding Case; and it soon had singular and surprisingly good Effects. For although the Suppression of the *Menstruæ*, the first Cause of the Disease, was not removed, her Spirits and Judgment have ever since been quite free and sound.

6. *Case 5.* "A young Lady, above 30, who was seized five or six Years ago with regular Paroxysms of a tertian Ague; as she was of a weakly Constitution, she had been twice before at the Gates of Death by that Disease: For though at first regular, it continued so long, and the Paroxysms redoubled so fast, as to leave little or no Interval betwixt them; and by that means the *Peruvian Bark*, and other Medicines, had little or no Effect. Observing therefore, that in all her Complaints she was much troubled with Phlegm in her Stomach and Bowels, I thought of giving her Lime-water; which, after cleaning the *prima viæ* by a Vomit and Purgative, had very good Effects. The first Fit, after using the Water, was milder than the former; the second more so, and the third scarce perceptible. Since which Time she has not had the least Threatening of a Return; but, by using the Lime-water for two or three Days, it is carried off. I could add many more Instances; but shall give only one, of the Effects of Quick-lime itself.

7. *Case 6.* "A strong robust young Country-fellow, about 20 Years of Age, was seized with an autumnal tertian Ague; for which he had taken many Things, and had checked it often with *Peruvian Bark*; but it as often returned. After proper Evacuations, I advised him to drink Lime-water; but he either could not, or would not drink a sufficient Quantity of it. I therefore

fore ordered him, before the Fit, gentle Doses of calcined Oyster-shells in Powder. He thought them so insignificantly small, that of himself he took a large Dose; which indeed gave him such a Pain in his Stomach, that he thought to have died of it. But from that Day to this, which is two Years, he has never had any more of the Ague, and been in perfect Health ever since. Adieu, D. D. and believe me to be your, &c.

Oz. 7. 1757. STEWART THRIPLAND."

8. *Case 7.* "The first Cause of my Trouble was a great Bruise on the Small of my Back, by a stumbling Horse falling above me; for which I was under Dr Dundas's Care from *February 1753*, while he lived. In *July* following I was seized with a kind of aguish Fever; my Urine and Skin became yellow, my Extremities swet much, and all my Nerves trembled so that it was not in my Power to hold a Spoon to my Head. This continued with me for three Years, notwithstanding all Care was taken of me by Physicians; a great Pain still continuing in the Small of my Back, till *February 1757*, when the Pain seized all my left Side, beginning at my Shoulder, and left Side of my Head, which swelled very big. Then I was blistered on the Shoulder, let Blood, and got Physic; yet the Pain passed over all my Side to my very big Toe, which likewise swelled; but no other Part swelled, but only the two Extremities: And I was so much pained for a Month's Time, that I could not put on nor off my own Cloaths; and when helped, it was with great Pain; till the 23d of *March*, that I began to drink the Lime-water, and drank above a Bottle every Day. The first Remark I made of it was, that it turned my Urine quite clear, for the Space of five Days; after which it turned it to its old Colour, yellow; but with a great Sediment, which it had not for near four Years before. Then I began to find Ease of all my Pains, attended with a good Appetite, which I had not for a long Time. I also made Trial, and left off drinking the Lime-water from the 14th Day of *May* to the 28th; when I found myself turning

6 *A Third Dissertation on Quick-lime.*

turning somewhat uneasy, and then fell to the drinking it again ; of which I find great Benefit : For I have as great Agility of all my Body, as when but 20 Years old, though now 57. I was also sore troubled with a Shortness of Breath, which has quite left me ; and also the *Tremor* of my Hands, which much disheartened me, fearing the Palsy. But, blessed be God, I have attained to a pretty good State of Health at present. This, with all thankful Acknowledgments, &c. from

June 18. 1757.

ROBERT MURDOCH."

9. *Case 8. James Pollock*, a young Man of a sound Constitution, till about 16 Years old, when he became very subject to Pains in his Stomach, sometimes accompanied with Sickness and Vomiting, till he was about 19, and which, as he thinks, brought on him a more severe Trouble ; for a violent Pain then seized his right Side, about the short Ribs, struck down to his Ankle, affected afterward his Shoulder, and, in a Word, it was not long before every Part of his Body had been roughly handled by it ; sometimes one Part suffering most, and sometimes another, with now and then short Intervals of Ease. In this State he continued some Months ; during which Time he was thrice bled, several times purged, by a Quack in the Neighbourhood, and the Parts anointed with *Dialthæa* ; but all to no Purpose. His Pains, accompanied with burning Heat, Stiffness, and Swelling, increased, particularly in his Neck and Back ; so that he could not hold up his Head, nor suffer a Cravat to be tied about his Neck, without being almost stifled for want of Breath ; yea he said the very moving his Eyelids increased his Pains. He had suffered thus about a Month, when he was directed to drink about a Bottle of Lime-water every Day. He followed the Advice, and found so much Ease the very first Night, that he commonly exceeded the prescribed Dose ; and much to his Advantage ; for the second Night his Pains left him, and he thought himself quite well ; but wisely continued to drink the Lime-water for three Weeks. It is now three Years since he was cured : He continues

continues to enjoy great good Health, and is a vigorous young Man. One Thing more deserves to be taken notice of; and that is, that he sometimes drank the Lime-water a little muddy, or not quite fine, till the Uneasiness it created in his Stomach taught him to be more cautious. *July 22. 1757.*

10. *Cafe 9.* "A young Girl, about eight Years of Age, and of a pretty healthful Constitution, was seized with very troublesome cuticular (commonly called *scorbutic*) Eruptions, of the dry scabby kind, in different Parts of her Body, particularly upon her Legs and Thighs, where there were some almost as broad as the Palm of one's Hand. To remove this Indisposition, which had continued for several Months, she used mercurial Purgatives, *Æthiops Mineral*, *Sal Polychrest*, and Sea-water: All which, in place of removing her Disorder, seemed rather to increase it. But by drinking Lime-water, and washing the Parts affected with it, for three or four Weeks, she had her Skin quite freed of any Eruption, and still continues so; and now it is more than a Year since she was cured." This by Mr Peter Adie, Surgeon. *Oct. 20. 1757.*

11. *Cafe 10.* Of many Instances which I could give of the good Effects of Lime-water, outwardly applied, particularly as a Gargarism, I shall give only one, but a pretty extraordinary one, and communicated by the Patient himself, a Person of Quality, in these Words. "I have been confined to the House near three Weeks. "I was ill when I set out for *Edinburgh*, and some time "before, but I thought nothing of it. But what with "Cold, Neglect, or perhaps fuller living, it turned to "a very dangerous Affair. I have got ten times Physic "in twenty Days, and that not weak. However, it "did not seem to yield to any thing, till my Doctor "thought of the Lime water; which carried it off in "a few Days, by washing (*the Mouth and Throat*) with "it. Of this you may acquaint Dr *Alston*. And that "he may know the Distress, it was the same which the
" old

“ old Physicians called the *Aphthæ*.” The Letter is dated *January 12. 1757.*

12. If to these be added, the Cases of an obstinate Dysentery (*a*), of an inveterate scorbutic Humour in the Legs (*b*), and of epidemic Fevers (*c*), cured by Lime-water; the extensive Use of it, as a Remedy for some of the most obstinate Diseases, must appear to be sufficiently confirmed by Experience. I shall proceed therefore further to explain some Passages in the Dissertations, beginning with what relates to the Action of Quick-lime on alcaline Salts (*d*).

S E C T. II.

13. Why Quick-lime combined with alcaline Salts so highly increases their dissolving and corrosive Qualities, is a Problem which few Chymists have attempted to explain (*e*): And I know no Experiments that bid so fair for a Solution of it, as those of my learned Friend the ingenious Dr *Joseph Black*, now Professor of Medicine in the University of *Glasgow*, which are published in the *Edinburgh Physical Essays*, vol. 2. art. 8. and seemed to command the Assent of every impartial Inquirer. Nevertheless, having carefully perused this Article, some Objections occurred against his Theory, which I cannot answer, and which I shall therefore propose, to give him an Opportunity, when he has Time, to remove them.

“ I imagined,” says he, “ that when the calcarious Earths are exposed to a violent Fire, and thereby converted into Quick-lime, they suffer no other Change in their Composition, than the Loss of a small Quantity of Water, and of their fixed Air. The remarkable Acrimony which we perceive in them after this Process, was not supposed to proceed from any additional Matter received in the Fire, but seemed

(a) *Phy. Eff.* 2. p. 257. (d) *Diss. 1.* p. 19. & 20.

(b) *Med. Obs.* 1. p. 286. (e) *Diss. 1.* p. 17. *Diss. 2.* Pref.

(c) *Appen. to Diss. 1.* p. 10. No. 5.

“ to

“ to be an essential Property of the pure Earth, depending on an Attraction for these several Substances which it then became capable of corroding or dissolving; which Attraction had been insensible, as long as the Air adhered to the Earth, but discovered itself upon the Separation.—Crude Lime was therefore considered as a peculiar acrid Earth, rendered mild by its Union with fixed Air; and Quick-lime as the same Earth, in which, by having separated the Air, we discover that Acrimony, or Attraction for Water, for animal, vegetable, and inflammable Substances.—If Quick-lime be mixed with a dissolved Alkali, it likewise shews an Attraction for fixed Air, superior to that of the Alkali. It robs this Salt of its Air, and thereby becomes mild itself; while the Alkali is consequently rendered more corrosive, or discovers its natural Degree of Acrimony, or strong Attraction for Water, and for Bodies of the inflammable, and of the animal and vegetable kind: Which Attraction was less perceivable, as long as it was saturated with Air.—If the Acrimony of the caustic Alkali does not depend on any Part of the Lime adhering to it, a Caustic or Sope-ley will consequently be found to contain no Lime,”
Ec. (a). But it may be objected,

14. *imo*, That the Acrimony of Quick-lime is here supposed to be much greater than it really is; for it is much milder than the alkaline Salts: Yea it does not appear to be of itself caustic; at least I know no animal nor vegetable Substance that it can properly be said to corrode, unassisted by alkaline or ammoniacal Salts. It attenuates Oils, and viscous animal Substances; but does not corrode the solid Parts, even of Animals (b). It is said indeed (c) “ to be too acrid to be tasted:” But that is to be understood of Quick-lime, so recently calcined, as to become burning-hot that Instant it is wetted. I once put a Bit of Quick-lime, in this State,

(a) *Phys. Eff.* 2. p. 185.—195.

(b) *Diff.* 1. p. 16. 17. and below, N^o 54.

(c) *Diff.* p. 16.

to the Tip of my Tongue, and might as well have touched a live Coal. But that Heat has nothing to do here, since flaked Lime may be as safely tasted as Lime-water; and yet flaked Lime, though nine or ten Months old, "will communicate to alkaline Salts a very high Degree of corrosive Acrimony" (a), yea render them as corrosive as the most recent Quick-lime, so far as I could discover. Whatever Attraction therefore Quick-lime may have for fixed Air, it is not by it soon reduced to an inactive calcarious Earth.

15. 2d, That there is no Lime in Sope-leys, seems to be inconsistent with Dr *Hales*'s Experiments; whereby he found, not only that Lime-water dissolved or rotted the *Calculus*, and that the Efficacy of Sope lies in the Energy which Lime gives the lixivious Salts; but also, that when all the Lime is separated from the Sope-leys, they are no better than dissolved Potash. "I evaporated," says he, "to Driness, strong Sope-leys, and took care to pour no more Water on the dry Salt, than had been evaporated away from it; whereby Regard was had to keep up a due Strength of the Sope-leys, which was also adjusted, with great Accuracy, by means of an *Hydrometer*: Which Sope-leys dissolved the Pieces of *Calculus* put into them, notwithstanding they had been thus deprived of some of their limy Matter; and they retained a Power of dissolving, after they had been thus deprived of more of their limy Matter a second Time. But when I repeated the Evaporation and Filtration a third Time, they were so thoroughly purified from the Lime, that they had no more Effect in dissolving a Piece of the same *Calculus*, than Ley of Potashes, neither in a warm digesting Heat, nor in boiling for half an Hour" (b). And it is no less inconsistent with the Experiments related in the second Dissertation (c). Besides,

(a) Diff. 2. p. 64.—68.

(b) *Vid. Exper. and Obs. on Mrs Stephens's Medicines*, § 8. 10. 21. & 53.—56.

(c) No. 17. 18. 19. especially 53. 54. 56. 59. 71. & 72.

That

That Lime does not constitute, at least in Part, the neutral Salt got from Sope-leys, does not appear to be proved by Dr *Black's* Experiments. It is true, he concludes it to be a vitriolated Tartar, which, he says, always accompanies the fixed Alkali of Vegetables" (a). But this neutral Salt is almost, if not quite insipid; and, without Ebullition, easily dissolves in Spirit of Vitriol, as well as in a small Proportion of cold Water: So differs much from vitriolated Tartar, "which requires a large Quantity of hot Water to dissolve it" (b); especially since a Solution of Pot-ash, treated the same Way, leaves no Salt, but only a little alkaline Earth, which makes a strong Ebullition with every Acid (c). And that some of the Lime, by its Union with a fixed Alkali, should acquire a saline Form, is not more strange, than that some of the Chalk sublimed with Sal Ammoniac, should become a volatile Alkali (d). But,

16. 3^{to}, The caustic Alkali seems not to be deprived of fixed Air. For in that curious Experiment, whereby the Doctor produced Lime-water without Quick-lime, or rather Quick-lime without Fire; which he thus explains: "In this Experiment," says he, "the Air is first driven out of the Chalk by an Acid, and the Acid separated from it by an Alkali, which has been previously deprived of its Air; by which means the Chalk it self is also obtained free of Air, or in an acrid Form" (e): I say, even in this Experiment, the Air is not driven out of the Chalk, nor the Chalk in this acrid Form free of Air; since it makes fully as great an Ebullition with Acids as does crude Chalk, as I found by repeated Trials; and consequently contains as much Air, according to his Theory.

17. 4^{to}, If the caustic Quality of Sope-ley be owing to the Alkali's being robbed of its fixed Air, then one would think, that such caustic Alkali's as are free of Air, or make no Ebullition with Acids, ought to be

(a) *Phyl. Eff.* 2. 203.

(d) *Macq. chym. prat.* 2. p. 444.

(b) *Ibid.* p. 162.

(e) *Phyl. Eff.* 2. p. 206.

(c) *Pref.* to *Diss. 1.* p. 10.

more corrosive than such as contain Air; whereas they are really less corrosive, or weaker: For Dr *Hales* found, that on dropping Oil of Vitriol into capital Sope-leys, which he bought of the Sope-boilers, an Effer-vescence was excited, till they were saturated therewith. "I dropt," says he, "into two Ounces of Sope-leys some Oil of Vitriol, till they were saturated there-with, so as to effervesce no more; by which means the limy Particles of the Sope-leys were precipitated to the Bottom," &c. (a.) I procured also some of the strongest Sope-ley made in the Sope-work at *Leith*, dropt into a Glas of it the Spirit of Vitriol, as well as the stronger Oil; each of which excited as strong Ebullition, as when dropt into a Solution of Potash. The saturated Solution continued quite clear and transparent; but the Sope-leys became muddy, and precipitated a Lime-like Substance, which smelted strong of Sulphur.

18. The same were the Appearances, when the Experiment was made with the strongest Sope-ley that I could prepare; yea and with every Sope-ley, when too great a Proportion of Lime was not taken: And if more Lime be taken than is necessary, the Lixivium cannot but be thereby weakened, on account of the greater Quantity of Water thereby required, as well as of the Salt retained in the Lime. Hence I found, that a Sope-ley made, according to Dr *Black*'s Proportions (b), of recent Quick-lime and pure Salt of Tartar, which must admit of more Lime than Potash, was much lighter than the *London* Standard (c); a Gill of it weighing scarce three Ounces six Drams and three Grains; whereas the same Quantity of the strongest Ley from *Leith* weighed four Ounces and one Dram.

19. I know the specific Gravity of the Doctor's cau-stic Alkali may be three Ways increased: *1mo*, By adding to it some fixed alkaline Salt; and accordingly I put into a Gill of it, only half a dram of Salt of Tartar.

(a) *Vid. Exp. and Obs. p. 11. N° 18. &c. 24.*

(b) *Phyl. Ess. 2. p. 200.* (c) *Ph. Lond. p. 42.*

But then it was no more the Doctor's caustic Alkali, since it made a brisk Ebullition with the vitriolic Acid. And it is also pretty remarkable, that this small Quantity of the Salt diminished the PELLUCIDITY of the Lixive, and caused a visible Precipitation; which must either come from the Salt, or there is Lime in his caustic Alkali's; since no such Precipitation followed when the same Quantity of the same Salt was dissolved in a Gill of pure Water. 2do, To bring a light Sope-ley to the true Standard, it may be thrown on fresh Lime and Ashes; as is observed in the *London Dispensatory* also. This Method I likewise tried, taking the half Quantity of the Lime and Salt first used, and keeping the Doctor's Proportions. But thus also it effervesced with Oil of Vitriol, as strongly as if it had been Oil of Tartar; while its specific Gravity was scarce sensibly increased. But, 3to, This may be effectually done by boiling down the Lixive. That both Weight and Strength of such Lixives may be thus increased, is commonly known. But Dr *Black* "soon perceived, that no certain Judgment could be formed of the Strength of his Ley in this Way, because it always absorbed a considerable Quantity of Air during the Evaporation" (a). May it not therefore be inferred, that the Doctor's caustic Alkali must absorb a considerable Quantity of Air before it become capital Sope-leys; that is, strong enough for making Sope?

2o. To ascertain the comparative Strength of the Doctor's Ley, I took flaked Lime, which I had kept ten Months dry in a Stone Jar, and Pearl Potash, of each half a Pound; put them into three Pounds of Water; and after a Day's Maceration, filtered what I could pour off tolerably clear; and had about four Gills of Lixive, weighing sixteen Ounces and two Drams; which made as strong Ebullition with Spirit of Vitriol as any of the former: And having conveyed into the Filtre the *Residuum*, and drained off so much of the Ley as reduced the Lime into a pretty solid Lump,

(a) *Phyl. Ess.* 2. p. 201.

and

and infused it in two Gills of fresh Water, next Day got a Gill of a weaker Ley from it, weighing three Ounces six Drams and fifty-two Grains: So about fifty Grains *per* Gill heavier than the Doctor's caustic Alkali. Of this weak or second Lixive I put a Spoonful into one Glass, and as much of the Doctor's caustic Alkali into another; and into each, in two Fragments, thirteen Grains of one and the same *Calculus*. When they had stood in the same Place forty-eight Hours unmoved, the Fragments in the weak Ley were reduced entirely to a Mucilage; whereas the Fragments in the caustic Alkali retained their Figure, the Surfaces being only cracked in several Places; and there remained six Grains of *Nuclei* as hard as ever. Hence the weak Ley appears to be near twice as corrosive as the caustic Ley. Ought not therefore their Names to be interchanged? Again,

21. *5to*, It may be objected, That it does not appear certain, that the Ebullition proceeds solely from the Air fixed in the alkaline Salts or Absorbents. Why may it not as well be fixed in the Acids? Because "Acids and Air cannot be joined to the same Body at "the same Time" (a). But they are conjoined in all acid Vegetables, in Vinegar, Tartar, Nitre, &c. yea in *Aqua Regia*: "For since Gold loses nothing of its "Weight in being dissolved in *Aqua Regia*, the Air- "bubbles cannot arise from the metalline Part" (b). Even "the fuming Spirit of Nitre, and Spirit of Sea- "salt, abound with Plenty of Air" (c). And that the strongest Acids do not drive out the Air fixed in the Bodies they dissolve, is confirmed by Experiment. For

I put into a little Phial, weighing, with the Cork, seventeen Drams and thirty-eight Grains, a fifty-two Grains Piece of a *Calculus*, and three Drams and two Grains of the Spirit of Nitre, corking it loosely, and giving Air frequently. Next Day the Ebullition being

(a) *Phyl. Eff.* 2. p. 185.

(b) *Vid. Hales's Stat. Eff.* vol. 1. p. 188. & 297.

(c) *Ibid.* 2. p. 310.

over, and the Fragment dissolved, the corked Phial, with its Contents, weighed (in the same Scales, which were both small and nice) twenty-one Drams and twenty-one Grains ; that is, was only eleven Grains lighter than before the Solution. These eleven Grains could not be all Air, because the strong Smell of the Spirit filled the Room near a whole Day ; to say nothing of the visible Vapour at first emitted, nor of what bubbled over during the Process. But allowing them to be all Air, it is not the Half of the Air which fifty-two Grains of a *Calculus* contain, by many Experiments (a). The strong Acid of Nitre, therefore, cannot set at Liberty one Half of the Air fixed in human *Calculi* ; but joins itself to it, as well as to the other Principles of the Stone. The diluted Solution I saturated with a Ley of Potash ; but a very little of a mucous Substance only precipitated ; which, separated by Filtration, and dried, did not amount to a Grain. The filtered Liquor was of a pale orange Colour, but dyed Linens red ; and exposed to the Air in a Drinking-glass, in Time shot into very odd blood-red Figures on the Sides of the Glass ; but at last lost that Colour, and became transparent and crystalline.

22. 6to, Neither is it certain, that the fixed Air is driven out of the caustic Alkali when it makes no Ebullition with Acids. Some Leys effervesce with Oil of Vitriol, but not with the Spirit ; others with the Spirit of Vitriol, but not with the Spirit of Vinegar. So there may be no Ebullition, not because fixed Air is wanting, but because it is too fixed to be driven out by the known Acids ; or an Acid strong enough to set it at Liberty is wanting. And, which seems to determine the Question, even Quick-lime, whether flaked or un-flaked, makes a strong Ebullition in Oil of Vitriol, in Spirit of Nitre, and Spirit of Salt ; consequently, according to the Hypothesis, the fixed Air is not separated from it by Calcination, nor the Acrimony of Sopeleys owing to the want of Air. And it were pretty

(a) *Vid. Hales's Stat. Edi. 2. p. 191.*

singular,

singular, if the same Degree of Heat which drives the fixed Air quite out of calcarious Earths, should leave so much of it in alkaline Salts, while Quick-lime, even without Heat, can rob them of it. And,

23. *Lastly*, It may be objected, That although it were granted, that crude Lime were a peculiar acrid Earth, rendered mild by its Union with fixed Air, Acrimony being the essential Property of the pure Earth; yet unless it be allowed also, that Acrimony is the essential Property of all pure Earths, it will not account for the Acrimony of the animal and vegetable Substances, which by Calcination can be reduced to Quick-lime. Is it the essential Property of the Juices which nourish the Shells of Eggs and Oysters? Besides, if fixed Air can render acrid Earths mild, why has it not this Effect on the Earth of alkaline Salts, which are allowed to possess a large Proportion of it, and yet are much more acrid than Quick-lime itself? I shall here only add, that since alkaline Salts and absorbent Earths are commonly known by their Effervescence with Acids, such Substances as do not thus act have been looked on as not alkaline. Hence the igneous Spirit of Sal Ammoniac is called by *Boerhaave* (a) *liquor volatilissimus omnium cognitorum, acerrimus omnium, neque tamen alcalinus*; whom I follow in the first Dissertation (b), tho' fully as antacid as the common Spirit. And on the same Account it is said (c), that Lime-water may be called antalkaline; since it placidly unites with Acids; but mixed with alkaline Salts, a Precipitation follows, though other Properties of an Alkali may belong to it in some Degree. But this by the by.

24. Dr *Black* having turned half an Ounce of Chalk into a kind of slaked Lime, by dissolving it in Spirit of Salt, precipitating the Solution with twelve Ounces of his caustic Ley, filtering it, and drying the Precipitation on a Chalk Stone; while the Solution seemed not to require so much Ley to precipitate it, nor simple

(a) *Chem.* 2. p. 333.

(b) p. 21.

(c) *Ibid.* p. 34.

Filtration and drying on Chalk appear to be sufficient to free it of all the Ley; which adhering Ley might considerably affect the Experiment; I thought it might be of some Use to repeat it; with a few Variations. Wherefore,

25. *1mo*, I dissolved two Drams of Chalk in about six Drams of *Glauber's Spirit of Salt*, which was so well saturated, as not to redden the blue Paper; then I precipitated the Chalk, by adding four Ounces only of a weak Sope-ley to the Solution, which appeared to be too much: For when diluted with two Gills of fresh Water, it was not only so acrid as to inflame the Lips and Tongue, when, with the greatest Caution, I attempted to taste it; but also precipitated nothing when I added a little more of the Sope-ley. The four Ounces were therefore enough, yea more than enough, to precipitate all the Chalk: Which confirms what was said above (*a*), of the Weakness of the Doctor's caustic Ley. The precipitated Chalk, separated by Filtration, and well dried, weighed 108 Grains: So twelve Grains probably adhered, partly to the Vessels, partly to the Paper, or might partly be owing to the Moisture in the crude Chalk: For it could not be fixed Air set at Liberty, since the precipitated Chalk effervesced as strongly, even with Vinegar, as crude Chalk does. The acrid filtered Liquor, upon standing two Days exposed to the Air, had a Cream on it, but not a cohering Pellicle or Crust.

26. I put a Dram of this precipitated Chalk into three Gills of Water; next Day filtered off two Gills; it had the Taste of Lime-water; and after two Days, one Gill of it (of the other afterwards) was covered with a thin Crust; but had lost its Taste. I added two Gills more of Water to the Chalk, and after two Days also filtered a Gill; which exposed two Days to the Air, was covered with a Cream. I repeated this a third Time, and in four Days it was also crusted. Then having poured off what was clear, I added to the *Residuum*

two Spoonfuls of Sope-ley, and two Gills of Water; next Day filtered the Mixture, and washed and dried the Chalk, which weighed forty-nine Grains; and being put into Water, continued still to communicate something to it, which in two or three Days appeared like a Scum on the Surface. Into the other Gill of the first Infusion I put an eight Grains Piece of a *Calculus*, which after three Days became white; but, after seven Days, had not lost half a Grain of its Weight.

27. *2do*, Having formerly dissolved Chalk in what I got for Spirit of Salt, and made also most of these Experiments with it, and with much the same Effect; though I found afterward it was rather a kind of *Aqua Regia*, because it precipitated a Solution of Silver in *Aqua fortis*, and the Paper through which the precipitated Solution was filtered, flashed like Nitre in the Fire; this put me on trying, whether other Acids would answer as well as Spirit of Salt. Accordingly I made the Experiment with Spirit of Nitre, Spirit of Vitriol, and Spirit of Vinegar; but all without Success. And,

28. *3tio*, To see if *Oleum Tartari p. d.* could supply the Place of Sope-ley, I precipitated a Solution of Chalk in Spirit of Salt with it; diluted and filtered the Mixture. What came through the Paper was milky and whitish; but being filtered a second and third Time, it became clear like Water; and exposed to the Air in a Tea-cup for twenty-four Hours, was covered with a transparent Pellicle; but the second Water threw up nothing. Hence this notable Experiment is not to be explained by an Acid's driving the Air out of the Chalk; for Spirit of Nitre, or any other Acid as strong as Spirit of Salt, would have done that as well. Hence also the Magisteries of Coral, Pearl, &c. once famous Medicines in the Shops, seem not to have been useles Preparations; being not only reduced to more subtle Powders than they can be by Levigation, but also more soluble and absorbent; and therefore less apt to form Concretions than the crude Substances are supposed to be.

29. It is observed in the first Dissertation (*a*), that

(*a*) P. 33.

“ by

“ by boiling Lime-water, and exposing it to the Air
“ for a short Time, it may be reduced to sweet Wa-
“ ter;” without determining how long it ought to be
boiled or exposed: This Defect may be supplied by
the following, or such like Experiments. I took three
Gills of Lime-water of the first Infusion, clear, but not
filtered, that it might be as strong as possible; decocted
it, only for ten Minutes, in a cylindrical Tin Pan of
five Inches diameter, and near three Inches deep; and
then exposed it to the Air in a Bowl, which can con-
tain about an *English* Pint of Water: and although it
was well covered with Pasteboard and Papers, in one
Day’s Time it scarcely tasted of Lime-water, and had
only a dusty Scum, but no Crust, on its Surface. The
second Day it was quite sweet, and free of Lime: For
being filtered, and again exposed for several Days, it
threw up nothing; nor did dissolving in it Salt of Tar-
tar cause any thing like a Precipitation. Hence it ap-
pears, that if no more Quick-lime be taken than is ne-
cessary to preserve the Water from Insects and Putrefac-
tion, or a Pound of good Stone Quick-lime for a Hogs-
head of Water, decocting for a Quarter of an Hour or
so, and exposing for one Day to the Air, will render it
fit for all the Uses to which the common Element is ap-
plied *.

30. This Experiment also confirms what is once and
again observed in the Dissertations, to wit, that Lime-
water exposed to the Air throws up Crusts or Cream, so
long as there is any Lime in it; and also, when it throws
up nothing, mixing Salt of Tartar with it can cause no
Precipitation: For if it could happen otherwise in any
Case, it would have happened in this, when nothing
was thrown up so soon as the third Day, and the Lime,
by boiling, might be supposed to be more intimately
united with the Water than it can be by simple Infu-
sion. Yet, in further Confirmation, and on account of
an Objection to an Experiment (a), I made a new one,

* See what is said of the Magnesia in the Preface to the said Dis-
sertation, § 2.

(a) *Vid. Diff. 2. p. 21.*

thus: I put three Gills of Lime-water of the first Infusion into the same Bowl, covering it as above. When it had stood five Days, and been twice or thrice stirred, to break the Crusts, during that Time, it seemed to throw up no more. However, I let it stand one Day more, then filtered, and found it as tasteless as common Water. In two Gills of this sweetened Lime-water I dissolved fifteen Grains of Salt of Tartar; but nothing like a Precipitation was visible. In a Word, by all the Experiments that I have made, it appears, that Lime-water thus exposed to the Air, commonly in five Days frees itself of all the Lime, if the Crusts be now and then sufficiently broken; though it may be kept good in close-corked Bottles for ten or twelve Months; but how much longer, I know not.

31. That Quick-lime may be of great Use at Sea, and particularly in the Distillation of Sea-water, is taken notice of in several Places of the Dissertations (a). *Illi qui aquam marinam salubrem et potabilem reddere conati fuerunt*, says a very learned Author, *banc imprimis difficultatem invenerunt, quod ingratum et subputridum saporem tollere non potuerunt: saltem enim marinum, qui in hac aqua adest, inde separare facile poterant* (b). What it is that gives this disagreeable and subputrid Taste to distilled Sea-water, is not easily determined. It cannot be the Salt; for, by the severest Tests, no Salt arises, though the Sea-water be distilled *per se*, or without any Addition. Nor does it appear to be an urinous Spirit; because mixing Quick-lime with Sea-water, though boiling-hot, does not alter the Smell, nor discover any such Spirit; and therefore making the Water boil any Time before the Recipient is applied (c), can be of little Use. But if it be a bituminous Substance, I am apt to think, that Quick-lime, which is far more fixed and penetrating than Chalk (d), and at the same time antiseptic also, should likewise more effectually prevent the rising

(a) Pref. to Diff. 1. p. 8.; Diff. 1. p. 33.; Diff. 2. p. 63.

(b) Van Swieten in Boerh. aphor. 3. p. 595.

(c) Diff. 2. p. 64. (d) Vid. Phil. Trans. vol. 48. p. 830.

of such Stuff, as well as correct the Taste of distilled Sea-water; which it seemed to do in some Degree, in the imperfect Trials that I made (a). But mixing a little Quick-lime with the distilled Water, and again separating it by boiling and Filtration, will do it more effectually. As for the Water distilled from Chalk, its Taste was fully as disagreeable as the Water distilled by itself.

32. Quick-lime retaining much longer its Qualities when it is flaked, or reduced to a Powder by throwing Water on it, than when kept dry, and falls down by what it imbibes from the Air; in comparing the Strength of Quick-lime with flaked Lime, Regard must be had to the Quantity of Moisture retained in the latter, with which many of the Experiments in the Dissertations were made. For if of flaked Lime a fourth Part, for instance, be Water, it must require four Drams of flaked Lime to be equal in Strength to three Drams of Quick-lime. Thus, if a Dram of ten Months old flaked Stone-lime was sufficient to make 387 Drams of Lime-water (b), eighty Grains of it would have made 516 Drams of as good Lime-water: Which eighty Grains, supposing it had been recently flaked, contained but about a Dram of Lime. Hence I was at some Pains to determine accurately how much Moisture flaked Lime contained; and by Experiment found, that twenty-nine Ounces six Drams of recent Quick-lime being flaked, weighed two Pounds five Ounces two Drams; and twenty Ounces one Dram twenty-four Grains of Quick-lime flaked by the Moisture of the Air, weighed twenty-eight Ounces and a half. I got it the Day it came in, *viz.* 13th of July; and it increased in Weight to October 7.; gaining in Weight the first ten Days four Ounces and an half, and the second two Ounces and two Drams, and the third half an Ounce; yet continues still increasing in Weight. So that the Quantity of Moisture in flaked Lime may be determined to be more than a fourth Part of the whole, when fla-

(a) Diff. 2. p. 33.

(b) Ibid. p. 33.

ked in Water; but when in the Air, above a third; that is, a Dram of the first above twenty Grains; but of the latter, about twenty-seven Grains.

Also, to make some Discovery how much Time weakens flaked Lime, when exposed to the Air, I put into six Gills of Water twenty-three Grains of flaked Lime, which I had kept dry forty-one Months; and into twenty-one Gills of Water, eighty Grains of flaked Lime only forty-nine Days old, both in corked Bottles. When they had stood a Week, and been every Day well shaken, and three Gills of each filtered, and exposed to the Air for another Week, the first yielded of Crusts $1\frac{1}{4}$ Grains, and the last six Grains. But if a fourth Part of each was Water, the first had eighteen Grains, and the last a Dram of Lime. The old Lime therefore yields but about a fourth Part of Crusts, in comparison of the recent, by this Experiment.

33. Though the Experiments which made me believe, that there are *Calculi* on which Lime-water can make no Impression (a), did not prove it, yet I have since found it to be too true. For, in December 1755, I got from Mr *Adie* the Fragments of a Stone, weighing four Drams, which he took from a Boy about fifteen Years old. They were of a coarse Grain, and not near so hard as the Stone wherewith I made most of the Experiments in the second Dissertation; and therefore broke in extracting. The Heart or *Nucleus*, as it were, was pretty entire, of a reddish brown Colour, rugged Surface, and about the Size of a Nut; the other Fragments more whitish in some Places, and reddish in others, consisting of two not very distinct Coats. A Piece of this Stone, of twenty Grains, I kept seven Days in a Glass of Stone-lime Water, and as long in Shell-lime Water; yet neither made any Impression on it: Yea it retained its Size and Figure, when three Weeks soaked in a strong Sope-ley, though penetrated thoroughly (b).

34. Hence we have one plain Reason of the Differ-

(a) Diff. 2. p. 12.

(b) Diff. 2. § 21. p. 15. and also Diff. 1. p. 40. § 9.

ence among Authors, concerning the lithontriptic Power of Lime-water; some affirming it absolutely, and others denying it altogether; as the right or faulty Preparation of it, may well be reckoned another; the Directions for making it, even in the latest Dispensatories, being still very defective (a). It is not pouring the Water on Quick-lime *paulatim*, *gradatim*, or *senzim*, and filtering when it has subsided, or letting it stand a Day, or two Days, before Filtration, yea nor boiling the Lime in the Water, that will make good Lime-water: For Water may stand several Days on the Lime without being impregnated, as is observed in the Dissertation, as just now cited. And I lately set Water with much Lime in it on the Fire, and kept it boiling for ten Minutes; yet, when filtered, it neither had the Taste of Lime-water; nor when exposed to the Air for several Days, was it crusted over, a thin Pellicle covering only Part of its Surface.

35. I know a learned Chymist says, that "the Water should be poured slowly on the Lime, otherwise a muddy Substance forms upon the Outside, which defends it from the Action of the *Menstruum*;" adding, that "this Liquor should be set in a cool Place, and not kept too long; for, on long standing, great Part of what the Water had taken up from the Lime will be separated, in form of a fine white Cream" (b). But I have found by long Experience, that it is altogether indifferent whether the Water be poured slowly on the Lime, or all at once, or the Lime thrown into the Water (c); for it will be equally well impregnated, provided it be well stirred, not at first only, (that will not be enough), but at least once more six or eight Hours after, and allowed to stand till it be crusted over. And I can assure the Chymist, that Quick-lime so greedily drinks in Water, that no muddy Substance can be formed on its Outside, or defend it from the Action of the *Menstruum*; and also that Lime-water will keep as

(a) Diff. 1. p. 28. and Diff. 2. § 38.

(b) New Diffens. p. 397. (c) Diff. 1. p. 29.

well in a warm as in a cool Place, a few Days only, if exposed to the Air; but many Months, if sufficiently defended from it (a). "Though the making of the *Aqua benedicta* is easy enough," says Dr *Quincy*, "yet here in *London* it may be had at any Time from the *Sugar-bakers*, by the Name of *Lime-water*, as wanted; because they use it much in refining their Sugars." And below, "This indeed cannot properly be called an *officinal Water*; because the easy making or proving it prevents its being kept in the Shops" (b); that is, it is too vulgar and cheap a Water to deserve a Place there. Hence perhaps it is, that the *Dispensatorium Ratisbonense*, an. 1727, orders it to be made of Water distilled from *Oak-leaves* (c).

36. The Inelegancy of Mrs *Stephens*'s Medicines for the Stone having occasioned several conjectural Improvements, as well as dangerous Experiments, I formerly proved, that *Sope-leys* diluted with twenty Times their Weight of Water, are too acrid to be taken inwardly (d); and I can now add, that thus diluted, they are a much weaker Lithontriptic than simple Lime-water. For a Piece of the hard *Calculus* often mentioned, of twenty-seven Grains, macerated a Week in about two Ounces of this diluted *Sope-ley*, was only whitened; but when washed well, and dried, had not lost a full Grain in Weight. I found also, that Dr *Hartley*'s alkaline Emulsion (e) is not only much more nauseous to the Taste than Lime-water, but also far inferior to it as a Remedy for the Stone: For, by Experiments, it clearly appeared, that Lime-water penetrated the *Calculus* fully as much, in the same Time, as did an equal Quantity of the Emulsion, when but three Days old, and reckoned stronger than when exposed to the Air for a Month. Now, if three half Pints of the Emulsion (the Dose prescribed by the Doctor being half a Pint, to be taken three Times a-day) be not more lithontriptic than three half Pints of Lime-water; surely

(a) Diff. 1. p. 11.

(d) Diff. 2. p. 48.

(b) Q. Pharm. p. 350.

(e) Ibid.

(c) Rieger introd. 2. p. 387.

three Pints, or three Quarts of Lime-water, which can be taken with great Safety, might have double or quadruple the Effect of the three half Pints of the Emulsion. And that even Quick-lime itself, whether recent, or exposed to the Air for several Months, is neither so safe nor so efficacious in the Stone as Lime-water, is demonstrated, I think, in the first Dissertation (a).

37. And since, notwithstanding the lithontriptic Power of the Urine of such as take that Lady's Medicines, is strongly asserted by her Partisans, it has been found, that every one of the Patients, whose supposed Cure procured her the parliamentary Reward, had a Stone in the Bladder at, and consequently to their Death, being all aged Persons, in whom, even after Lithotomy, there is seldom, if ever, a new Stone formed; while all the Virtues of these Medicines are derived from the Lime; it appears to be absolutely certain, that Lime-water is possessed of all the lithontriptic Powers of Mrs Stephens's Medicines; and that, if taken in sufficient Quantity, and so much *Alicant Sope* along with it, as will keep the Belly in its natural State, it will prove every way as successful, and by far a more safe and agreeable Remedy for the Stone, than her nau-*feous* Prescriptions, or any Reformation hitherto made, or perhaps that can be made of them.

38. That Lime-water does not break the Stone by destroying the *sales calculi volatiles*, as Dr Schloffer would have it (b), nor by dissolving the animal *gelatina*, to which the Cohesion of its Parts is ascribed by Dr Springs-*feld* (c), for Water might do that; nay nor by setting at Liberty, or driving out the Air, of which near one Half of the Stone is said to consist, seems to be proved already (d), and confirmed by what follows. I took two pretty similar Fragments of a *Calculus*, each weighing just five Grains; put one into half a Gill of

(a) P. 40. N^o 10. (b) Phil. Trans. vol. 49. p. 236.

(c) *Vid. Got. Car. Springsfeld commentatio de prærogativa thermarum Carolinarum in dissolvendo calculo vesicæ, præ aqua calcis vivæ*, Lipsiæ 1756, in 4to, p. 15.

(d) *Diss. I. p. 39. 40.*

Shell-lime Water, and the other into the same Quantity of Stone-lime Water, in Drinking-glasses covered with Paper. After ten Weeks, the Moisture being evaporated, and the *Residuum*s quite dry, each weighed six Grains and a half; that is, rather more than equal the Weight of both the Fragment and the Lime in the Water; there remaining of the Fragment in the Shell-lime Water unpenetrated two Grains and a half, and of the other two Grains.

S E C T. III.

39. In the *Philosophical Transactions* (a), there is a *Tentamen chemicum, de calcis vivæ actione in salem volatilè alcalinum*, by Dr Schloßer of Utrecht; where, in a Note on p. 224. concerning the Question, Whether the Precipitation on mixing Salt of Tartar with Lime-water comes from the Lime or the Salt? the Doctor gives his Opinion thus: *Quæstionem certe hancce (quam minime parvo illorum experimentorum numero diremptam credo) e medio sublatam fuisse, omnes procul dubio lætassent chemici, simulque actio calcis vivæ in alkali volatile facilioris forte reddita fuisse explicationis. Sed quænam quæso est necessitas, ortum ejus pulveris e solo sale solave calce repetere? cur partim salinæ, partim calcariæ originis esse non posset?* But, even in the first Dissertation (b), the Precipitation is only said to be chiefly from the fixed Alkali. The Words are, “ That the Precipitation was chiefly “ from the fixed Alkali, I think more than probable; “ because the three Grains of the first Precipitation, was “ more than double the Quantity of Lime contained “ in three Spoonfuls of Lime-water” And had the learned Doctor seen the second Dissertation, he would not perhaps have thought the Experiments so few or inconsiderable; nor that we imagined, that the Powder proceeded *e solo sale solave calce*; it being there owned, that commonly, if not always, Part of the *præcipitans*

adheres to the *præcipitatum*; and consequently that the Powder is *partim saline*, *partim calcariae originis* (a).

40. But the original Question betwixt my Friend and me was, Whether the Lime-water or the Salt ought more properly to be called the Precipitant (b)? or whence comes the greater Part of the Precipitation; from the Salt, or from the Water? I own my Friend seemed to go further afterward, and think the Powder came entirely from the Lime-water; and that in consequence of the Theory adopted by him, and by no less a Man than the celebrated Professor Hoffman, as well as of some Experiments made by himself; which Dr Black also seemed afterward to confirm (c); from whom however I have the Misfortune to differ: For to me the Precipitation appeared, by Experiments, to come, at least sometimes, chiefly from the Alkali, and differed from the calcareous Earth of the Lime-water (d); though to define positively what Proportion of the Powder comes from the Lime-water, or from the Salt, when mixed as in the second Dissertation, N° 54. is not easy.

41. In order to throw some Light on this Question, I kept some of the white Powder in a red-hot Crucible for above ten Minutes; which I thought would have reduced the Crusts of Lime-water to Quick-lime; but the Precipitation was not thus calcined, so as to communicate any thing to the Water. But the white Powder being kept above an Hour in a more intense Heat, it was turned, at least in Part, into Quick-lime: For three Drams of it being infused in about six Ounces of Water, it had next Day the Taste of Lime-water, and was thinly crusted over. Ten Grains of Salt of Tar-tar, dissolved in a Gill of this Lime-water, yielded only one Grain and an half of white Powder. But because this Precipitation was old, and had been collected at different Times, lest any thing might have been

(a) Diff. 2. p. 43.

(b) Diff. 1. p. 10. § 15. p. 20. § 6.; Diff. 2. § 59.

(c) Vid. supra, N° 15.

(d) Diff. 2. sect. 4.

accidentally mixed with it, I carefully prepared eighty-four Grains of it pure and unmixed.

42. These eighty-four Grains of precipitated white Powder, being put quite dry in a Crucible, and kept red-hot in a strong Fire for more than two Hours, became a solid Mass, in Colour and Hardness not unlike common Chalk, but whiter, weighing only forty-six Grains; so diminished thirty-eight Grains in the Fire: Since this white Powder can scarcely be supposed to have retained more Moisture, when perfectly dry, than do the Lime-crusts (a). Of these thirty-eight Grains there could not be six Grains, at least not eight Grains of Water; nor, since the remaining calcined Powder made as great an Ebullition with Acids as does common Chalk, could any considerable Part of the thirty-eight Grains be fixed Air. At least, therefore, about thirty Grains of the Earth of this white Powder must have been driven away by Heat. And it being commonly known, that Lime is more fixed in the Fire than any alkaline Salt, is it not probable, that only the Earth precipitated from the Alkali could be thus dissipated or driven away? So by this Experiment it appears, that more than a third Part of the Precipitation is from the alkaline Salt; when, to wit, for each Gill of Lime-water ten Grains of Salt of Tartar are taken (b).

43. A Gill of Water being poured on this little Mass of forty-six Grains, it did not grow hot, nor fall down like Quick-lime; yet next Day the Water had the Taste of Lime-water, and was crusted over. I filtered what I could pour off clear, and filled up the Tea-cup with fresh Water, having broken down the Mass into small Bits and coarse Powder, and next Day again filtered, and filled up the Cup. This I continued to do for a Week or so, and afterward every second or third Day, till I had collected above twelve Gills of this Lime-water; keeping always the same Filtre, but not the same Phial; and the very last Infusion was crusted, and tasted like the first: And having dried all

(a) *Diff. 1.* p. 10.

(b) *Vid. Diff. 2.* N° 57.
fully,

fully, I had of undissolved Lime remaining twenty-eight Grains, and of Crusts in the Filtre twenty-five Grains, in all fifty-three Grains; that is, seven Grains more than the little Mass weighed at first: Yet two Gills of the three first Infusions, exposed six Days to the Air, gave four Grains of Crusts. Now, supposing the other ten Gills would have yielded twenty, or even fifteen Grains only of Crusts, the Mass of forty-six Grains, which should have been reduced to twenty-seven Grains, on deducing the nineteen Grains of Crusts, was increased to seventy-two Grains (*a*).

Into half a Gill of this Lime-water I put a Piece of the *Calculus* often mentioned, of twenty Grains Weight; and after three Days Maceration, it weighed very near nineteen Grains; which being treated again the same Way, in three Days lost just one Grain. Hence it appears, that Water cannot take up near so much of this recalcined Lime as of common Quick-lime, perhaps little more than one Half of it. And is it not thence probable, that Part of this recalcined Mass is also *sali-nae originis*? Upon the whole, it seems not improbable, that by mixing Salt of Tartar with Lime-water in the above Proportion, more than one Half of the Lime in the Water is not precipitated, if so much (*b*).

44. Now, although it is not improbable, that, by repeated Calcinations, all the precipitated Powder may be so reduced into Quick-lime, as to be entirely soluble in Water; and though it should also be granted to *M. Macquer*, that fixed Salts hinder the Calcination of calcarious Substances (*c*), which is not quite certain, as will appear below (*d*); yet it could not, with any Probability, be thence inferred, that all the precipitated Powder comes from the Lime. For it must be considered, that what is separated from the fixed Alkali, even by repeated Solutions in common Water, or the Moisture of the Air, as well as by Precipitation with Lime-water, is not a Salt, but mere Earth; and so

(*a*) *Vid. Diff. 1. p. 7. N° 11.* (*c*) *Elem. de chym. p. 54.*

(*b*) *Vid. Diff. 2. p. 16. N° 2.* (*d*) *N° 50.*

could

could not obstruct the Calcination of the calcareous Part, yea may itself be reducible into Quick-lime; especially if *calx viva sit vera terra alcalina, cuius debita cum aliis elementis unio, salem alcalinum fixum probet*; as Dr Schloffer asserts (a). But whatever is in this,

45. It is certain, that Quick-lime mixed with dissolved alkaline Salts, as in the Preparation of Sopeleys, diminishes considerably the specific Gravity of the Solution, and consequently separates some of the more solid Parts of these Salts, whereby its own Weight is proportionally increased; as appears by Experiments (b), once and again, yea and a third Time repeated. And since Earth, if alkaline Salts be composed of different Principles, must be the least active, there is, I think, Reason to conclude, that Quick-lime renders them more acid, subtil, and penetrating, by separating from them, or uniting to itself, Part of the Earth, than of their more active Principles, to which their specific Qualities are owing; to say nothing of what it communicates to them of its own Substance (c).

46. And since Quick-lime acts thus on fixed alkaline Salts, it is not improbable, that it acts analogously on the volatile; not by separating from them any Part of the Acid and Phlogiston, as Dr Schloffer would have it; since on the Union of these with the earthy Principle their specific Properties depend. *Ipsa momento*, says he, *quo calcis vivæ particulæ, quæ in aqua calcis soluta hærent, veri salis alcalini volatilis particulas tangunt, laetescens fit, et calcis vivæ particularum præcipitatio sequitur. Simul vero compages salis volatilis alcali in ipsa sua textura dissolvitur, acidi ejus, parcique phlogisti sui particulis, magna parte per præcipitatam calcem attractis, et cum eo coeuntibus, dum reliqua salis alcalini volatilis pars junctura (jactura?) longe acrior, et amissa quasi corpore suo, vere spirituosa redditæ, spiritum igneum Boerhaavii verum constituit: qui igitur in eo tantum a vero sale alcalino volatili differt, quod particulis hisce acidi atque phlogisti sui maxima*

(a) Phil. Trans. vol. 49. p. 236.

(b) Diss. 2. p. 46.

(c) Vid. Diss. 1. p. 19. N° 6.

parte

parte privatus fuit, quibus debite restauratis, spiritus igneus verum in salem pristinum totus quantus regenerabitur (a).
Thus he.

47. If an igneous Spirit by an Acid and Phlogiston had ever been turned into a volatile Salt, our Author's Hypothesis would have some Foundation. But neither his own, nor *M. Du Hamel's* Experiments (*b*), any way support it, or make it at all probable; and he owns *quod restat probandum*, without attempting to prove it. Nor can I see any Relation between his numerous Experiments and his Hypothesis, which is only a conjectural Explication of the Cause of the Precipitation on mixing volatile Sait with Lime-water; which he might have deduced, with as much Evidence, from the very first Experiment in the first Dissertation (*c*); his other Experiments proving or illustrating nothing, that I can observe. So I may be allowed to say, *Quæstionem hancce, magno ejus experimentorum numero, minime diremptam credo.* But to proceed:

48. Since at least as much, or rather, as some Chymists assert, much more volatile Salt is obtained by subliming Sal Ammoniac with Chalk, than by the *intermedium* of a fixed Salt, yea and more either Way than the Weight of the crude Sal Ammoniac taken, Part of the Intermède must be volatilized, and intimately united with the true volatile Salt; and consequently the one contains more Earth than the other; or what is carried up from the Salt, must be of the same earthly Nature with what rises from the Chalk; which is not probable; these two volatile Salts differing much many ways, and particularly in Volatility. And since it is owned, that their Volatility and Acrimony are owing to something else than the earthly Principle, I cannot but think, that the volatile Salt got by means of a fixed Salt, is more acrid than what is got by Chalk; and consequently, that, not by increasing, but by diminishing the Proportion of the Earth to the other Principles, the Acrimony

(a) *Phil. Trans.* vol. 49. p. 234.

(b) *Vid. Macquer chym.* I. p. 447. (c) p. 21.

and

and Subtilty of the volatile Spirits can be increased. And since a much smaller Quantity of Spirit can be obtained, by subliming Sal Ammoniac with Quick-lime, than any other Way, and always in a liquid Form, for want of a sufficient Quantity of Earth, which the fixed Alkali, as well as the Absorbents, afford, and is necessary to give a Body to the dry or solid Salt, but which the greater Fixity of Quick-lime hinders to arise; it appears to be far more probable, if not certain, that Quick-lime, in transforming volatile Salts into igneous Spirits, separates some of the Earth, and not any Part of their other Principles. If Dr *Schloffer* had distilled the Sal Ammoniac all the three Ways, and chymically examined and compared the Products, and other *phænomena*, he would probably have given a more satisfying Solution to this Question than he has done. Whether either fixed or volatile Alkali's contain, or consist of the Principles attributed to them by our Author and others, I leave to the Chymists to determine. But that Quick-lime separates some Earth from volatile Salts, seems to be confirmed by the following Experiment.

49. I infused an Ounce of flaked Quick-lime in two Gills of Spirit of Sal Ammoniac, sublimed from a fixed Salt, (each Gill weighing twenty-nine Drams), for fourteen Hours, mixing them well several times; and having poured off and filtered a Gill, found it weighed twenty-eight Drams and thirty Grains, or thereby: So diminished in specific Gravity about thirty Grains, or a fifty-eighth Part. And if the specific Gravity of the igneous Spirit of Sal Ammoniac be to Water as 890 to 1000, as in Dr *Davies's* Tables (*a*); and of Spirit of Sal Ammoniac with a fixed Salt, as 952, as in the *New Dispensatory* (*b*); the specific Gravity of the common igneous Spirit, differs very little from that of the limed Spirit of Sal Ammoniac; and consequently confirms the above Reasoning. It was remarkable also, that tho' the filtered Spirit was at first clear like Water, it soon

(*a*) *Phil. Transf.* N° 488.

(*b*) *P. 4.*

became

became milky and opaque; but in a Night's Time clarified of itself, by precipitating Part, and throwing the rest of the earthy Substances that muddied it, on the Sides of the Phial, to the Quantity of six Grains. Is it not therefore probable, that Quick-lime separates from volatile Alkali's also Part of their earthy Principle?

50. To see whether alkaline Salts prevented the Calcination of calcarious Substances, I calcined, for four or five Hours, some of the Lime remaining of the Sopeley mentioned above, N° 18. without washing it, and consequently loaded with fixed Salt, and poured Water on it. This first Infusion was a kind of Sopeley; and so, though it stood several Days, it had but a thin Crust over it. But the second Infusion was much sooner crusted, and the third Infusion in one Day's Time. And although the Alkali was Salt of Tartar, yet this recalcined *Residuum* became black, or rather of a very dark bluish green Colour, in the Water; which sooner discoloured Silver, and had a more offensive sulphureous Taste and Smell, than the Lime-waters made of ill calcined Oyster-shells. Hence Salt of Tartar retains Sulphur, even after repeated Calcinations; but does not always hinder the Calcination of calcarious Earths.

51. The learned Dr *Springfeld*, in his *Commentatio*, taken notice of above, N° 38. makes the Power of the *Caroline* Baths, or *Carlsbadt* hot Waters, in dissolving the Stone, to be at least six times stronger than that of Lime-water, though its Virtues as a Lithontriptic, seem to be owing entirely to the Lime in it. This little Commentary being rare here, the Experiments it contains curious, and the Facts almost incredible, some Account of them, with a few Remarks, cannot be unacceptable to the Reader. There are two of the Experiments which deserve more particularly to be taken notice of. The first he thus relates. *Sumebantur tria frustula calculorum semidrachmæ ponderis singula. Ingerebatur quodvis in phialam vitream æque capacem. Uni a fundebatur aqua calcis, ex ovorum testis nuperrime uscis parata; alteri aqua thermarum; et tertio urina hominis eandem aquam quotidie bibentis, ante prandium reddita. Ponabantur*

bantur in loco tepido, ubi thermometrum Fahrenheitianum ad gradus 96. qui est calor sanguinis humani, ascendebat. Renovati erant liquores quotidie per 14 dies. Die 15. ponderabat frustulum siccatum ex aqua calcis grana 29. alterum ex aqua thermalis gr. 24. tertium ex urina gr. 25. (a). If the Fragments were of one and the same *Calculus*, the Egg-shells seem to have been ill calcined, or the Lime-water ill prepared; there being few *Calculi*, of which any right Lime-water, thus managed, would not have dissolved into a Mucilage, more than five Grains in fourteen Days Time.

52. In the other Experiment, he took four equal Fragments of a *Calculus*, each weighing four Scruples; put them into Phials as above; pouring on the first Oyster-shell Lime-water, on the second the mineral Water, on the third the Urine of a *Boblinus*, that is, one drinking these Waters; and on the fourth the *urina hominis sani*; placing the Phials and renewing the Liquors as in the former Experiment. After twenty Days, the Fragments being dried and weighed, the first had lost almost three Grains, the second eighteen, the third fourteen, and the fourth had gained three Grains (b).

Not to repeat what was said on the former Experiment, it may be here remarked, that the lithontriptic Power of each of the first three Liquors in this Experiment, appears to be double to what it was in the former. For if Lime-water in fourteen Days dissolved only one Grain, it would not in twenty Days dissolve fully one Grain and a half; for $14 : 20 :: 1 : \frac{12}{5}$; and for the same Reason the Bath-waters would dissolve about eight Grains and a half, and the Urine very little more than seven Grains. If this Difference is owing to the greater Solubility of the Stone, I may venture to affirm, that right Shell-lime-water thus managed would have reduced to a Mucilage, or washed away more than twenty Grains, in that Time, of such a Fragment (c).

(a) Comment. p. 10.

(b) Comment. p. 11.

(c) Vid. Dr Whytt's Essay, p. 27. &c.; also a Note on p. 474 of the Scots Magazine for August 1757.

53. It may be observed also, that by these two Experiments, made when Dr Lieberkun was present, the dissolving or lithontriptic Power of the Caroline Baths, is much weaker than it appeared to be by those made by the Author alone. For, according to them, a *calculus vesicæ* of two Ounces and a half, *lateritii coloris, in vase porcellana, prope scaturiginem fontis, ita positus, ut aqua calida continuo bumeataretur, spatio sex dierum erat dissolutus.* In fundo vero vasis conspiciebatur materia quædam alba, viscida instar pultis, inter digitos enim sentiri nequit. And another Stone weighing two Drams, *bodii coloris, torno quasi politus, siliceæ fere duritiei, in aquam immersus, sacculo raro inclusus, mirum dittu!* cæteris citius dissolutus fuit (this is a Mistake). Post 24 horas enim restabant duo tantum grana (a). So that of this flinty Stone above six times more is dissolved in one Day by the same Water, than was dissolved by the Experiment N° 52. *supra*, in twenty Days. For, by the first Experiment, in the Order I mention them, there was not $\frac{1}{6}$. of half a Grain of a Fragment of thirty Grains dissolved in one Day's Time; by the second, not fully a Grain of $\frac{1}{18}$ of an eighty Grains Fragment; by the third, no less than 200 Grains of a Stone weighing two Ounces and a half; and by the fourth, 118 Grains of a Stone of two Drams Weight; all in the same Time, to wit, one Day. Here a very great Difference of the Effect of the same Waters on the *Calculi*. Can the Influence of the Air account for it (b)? Again,

54. Notwithstanding the lithontriptic Power of the Urine of such as drink these Waters, much insisted on by our Author, we find that a *Reverendus quidam*, even while he was drinking them, passed six Gravel-stones undissolved. Yea an *Illustris Comes*, whose Urine, made once a-day, on six Grains of small Stones, formerly passed by himself, reduced them in eight Days to two Grains; even he passed some hard, though small Stones, during the Use of the Waters; *largior quidem*, says he, *per duos tresve dies, hos subsecutus est mictus sanguinis, qui*

(a) Comment. p. 7. & 8. (b) Vid. Diff. 2. p. 13. N° 18.

tamen postea cessavit (a). One would think, that the Use of these wonderful Waters, for a very few Days, should have dissolved, or at least so softened or smoothed the Surfaces of these little Stones, as to prevent their causing bloody Urine for an Hour.

Experimentis indubitatis probavi, says he, *aquam thermalem semper abundare parte alcalina.* *Continet enim, praeter salem medium amarum, quælibet libra aquæ tria grana salis alcalini, et decem grana terræ calcariae, quare cum omnibus acidis effervescit.* — *Si per aliquot horas in balneis fletit, non solum lactescit ut aqua calcis, sed illi innatæ quoque cuticula tenera terrea, qualis super aqua calcis observatur.* *Gaudet quoque sapore illo leniter constringente atque exsiccante, ut perum alibi quin eam cum aqua calcis vivæ confunderes, nisi sapor falsus aliquod leve daret discrimen (b).*

55. Hence it is not improbable, as I said, that the Virtues of these Waters in the Gout, as well as in the Gravel, is owing chiefly, if not solely, to the Lime in them, of which they contain no more than does common Lime-water; and how they should so much excel it in Virtues, is not easily explained: For I know no neutral Salt that has any Effect on the Stone, and fixed Alkali's very little. Far less can they improve the Taste of the Water; of which Taste the Author speaks somewhat differently towards the End of his Commentary. For *tantum abest*, says he, *ut usus thermarum Carolinarum æque nauseosus sit, atque aqua calcis vivæ, ut potius, per 6. 7. & 8. menses, sine omni incommodo continuari possit; quod de aqua calcis vivæ affirmari nequit.* By what the Author says of the Lactescence and Taste of his Lime-water, it seems to be very different from ours. For Lime-water here, if pure, soon gathers a Crust or Cream on its Surface, but never grows milky below. And as for the Taste of simple Lime-water, rightly prepared, it is neither *constringens* nor *nauseosus* to me, nor to any one that will use it for a Day or two (c), so far as I can find; yea I prefer its Taste to that of pure Wa-

(a) *Comment.* p. 9.

(b) *Ibid.* p. 7.

(c) *Vid. Diff. 2. p. 59.*

ter, for common Table-drink; and as such have used it, not only for seven or eight Months, but for eight or nine Years, *et sine omni incommode*. Nevertheless,

56. The *Caroline* Baths, being a natural compound *aqua calcis*, and so perhaps may surpass all the known artificial ones, I thought it not amiss to attempt an Imitation of it; and into an *English* Pint of Lime-water put three Grains of the Salt of Tartar, and as much *Epsom* Salt. The Mixture became immediately milky, and soon precipitated. When pretty clear, I dropt into a Glass of it some Spirit of Vitriol, which clarified it fully, but without any visible Ebullition. Into another Glass, containing about half a Gill of this Mixture, I put two Fragments of a *Calculus*, weighing together thirteen Grains. Next Day this compound Lime-water was not only covered with a Crust, but the Fragments also with numerous snowy Efflorescences, and to a considerable Thicknes the Day following. At the End of the third Day, being washed and wiped dry, they weighed only nine Grains. So here, in three Days, four Grains were reduced to a Mucilage; whereas of a thirteen Grains Piece of the same *Calculus*, only two Grains and a half were thus dissolved in a Week, either in Stone or Shell Lime Water (a). The Glass also was crusted to the Bottom, which it never is with pure Lime-water. This appeared to be a considerable Discovery; and to ascertain it the more, I put the remaining nine Grains of the two Fragments again into the same Quantity of the Liquor: But after seven Days Maceration, they had lost but two Grains of Weight, seven remaining as hard as ever.

57. Not yet satisfied, I infused in the same Quantity of this compound Lime-water, fourteen Grains and a half of the same *Calculus*, in three Fragments; and the same Quantity of the same Stone, in three Fragments also, in a like Quantity of single Stone-lime Water. And though the former appeared to be sooner penetra-
ted than the latter; yet, after three Days Maceration,

(a) Diff. 2. N^o 20.

being

being washed and dried, neither had lost fully two Grains in Weight. Thus I compared also the Strength of single Lime-water, with Lime-water in a Pint whereof only three Grains of Salt of Tartar were dissolved, by infusing in an equal Quantity of each the Remainders of the former Experiment, for three Days and six Hours; and the Appearances were much the same, neither having lost two Grains fully. Here also the tartrized Lime-water crusted the Glass to the very Bottom; which is the Reason perhaps that our learned Author makes his Bath-waters, on standing, to turn milky. It does not therefore appear, that the lithon-triptic Virtue of Lime-water, is either sensibly increased or diminished, by dissolving in it so small a Proportion of Salt of Tartar, either by itself, or together with an equal Quantity of the *sal catharticum amarum*, notwithstanding the Precipitation; which may be a Discovery not quite useles, in some Cases, nephritic particularly, accompanied with Inflammation or Costiveness.

58. But a Pound of *Epsom* Water, yielding at least half a Dram of Salt, I dissolved thirty Grains of this Salt, and three Grains of Salt of Tartar, in a Pint of Lime-water as formerly; and when pretty well purified *per subsidentiam*, put into half a Gill of it, an eighteen Grains Fragment of the *Calculus*. After three Days Maceration, the Fragment being wiped and dried, weighed more than $17\frac{1}{4}$ Grains; so lost little more than half a Grain. The Precipitation, separated by Filtration, being dried, weighed ten Grains: It was hard and brittle, and so chiefly from the bitter Salt. The remaining Fragment, put into pure Lime-water, tho' seven Days macerated in it, lost nothing. *Epsom* Salt therefore ought not to be used along with Lime-water, if it be not in a very small Quantity.

59. In the first Dissertation (a), it is asserted, that a Piece of Veal buried in flaked Lime, in ten Days became as hard as a Mummy; and that it had the same Effect on Beef: Whereas a great Man says, "I put a

(a) *Vid.* Note on p. 16.

" Piece

“ Piece of Veal, from half to three Quarters of an Inch thick, into Chalk-lime, on the 10th of *May*; and on the 31st of the same Month it had a putrid Smell, and was in the Middle red and raw, with a thin hard Outside” (a).

Although I had no Reason to suspect the Accuracy of my Experiment, yet the Regard due to such a Character obliged me to renew it. Accordingly I put a Piece of Veal, from five Quarters to two Inches thick, weighing 222 Grains, into flaked Stone-lime, on the 2d Day of *May* last. It had been kept some Days, and was beginning to smell. On the 4th it smelted more offensively; on the 10th it had no Smell, and was pretty firm; and on the 12th of the same Month I took it out, and it was hard throughout, as a Horn almost, and weighed only seventy-one Grains. The Veal and Beef mentioned in the Dissertation I keep still, and they are as found and hard as ever; the former weighing thirty-six Grains, and the Beef 123. The Lime wherein all these Pieces of Flesh were buried, was in a Stone Jar, wherein Raisins are imported, and almost half filled it. There must therefore either be a very great Difference between Stone-lime and Chalk-lime, or the Chalk not completely calcined, or in too small a Quantity.

60. Since it is certain, by many Experiments, made by others as well as by myself, that Lime-water powerfully resists Putrefaction, as well as attenuates viscous and fizzy animal Juices; it is not to be wondered at, that Fish or Flesh long infused in it, though no wise corrupted, yet, when boiled, should become very tender and pappy: Which explains, or rather confirms the Efficacy of this Liquor in Diseases from Viscidity of the Fluids. This is therefore so far from being a bad Quality, that it renders it many other ways useful (b). Whether Lime-water’s dissolving the Texture of Flesh into a Pap, must be the Effect of *unfetid Putrefaction*, or of some other Cause, I shall not inquire. Only, since

(a) Phil. Trans. vol. 48. p. 830.

(b) *Vid. Pref. to Diff. I.* p. ix. & p. 46.

this Solution is very analogous to the Change Flesh must undergo in the Stomach, or before it becomes Chyle, and fit Nourishment for the Body, and consequently a salutary, not hurtful Change; I am apt to think, that the Term *Putrefaction* must be taken in too large a Sense, and divested of its common offensive Signification, before it can here be properly applied.

S E C T. IV.

61. Although the Dissertations could not fall under the Censure of the *Critical Reviewer*, yet Lime-water has not escaped it. "The eighth Article," says he, (of the second Volume of the *Edinburgh Essays and Observations, &c.*), "contains Experiments on *Magnesia alba*, which, though a fashionable Purge, is a very insipid, uncertain, ineffectual Medicine; and does more Harm by clogging and furring the Stomach and *privemæ viae*, than any Benefit that can be expected from the Use of it." In this Article, as there are many new and curious Experiments relative to the History, Qualities, and Effects of this *Magnesia*; so, when judiciously administrated, it is neither an uncertain nor ineffectual Medicine. Its Insipidity renders it more generally useful, because easily taken; as its being dissolvable in the weakest Acids, and purgative Quality, prevent its furring the Intestines. As to its Effects on Lime water, which makes it of great Use at Sea (a), it is taken notice of by the learned Author of the Article, as one of the singular Properties of this Substance. But the Virtues of that Liquor are foreign to his Subject, and untouched by him. Yet the Reviewer takes Occasion thence to make a Fling at it.

"With respect to Lime-water," says he, "it is a coarse, inelegant Preparation, and of very doubtful Efficacy, notwithstanding all that has been said in its Praise, by the Physicians and Chymists of *Edinburgh*. At the same time, we must allow, that in some Ca-

(a) *Vid. Pref. to Diff. I. N^o 1.*

" ses

“ ses it has produced very salutary Effects” (a). But with what Propriety a Liquor more transparent than Crystal, and more subtile and penetrating than pure Water, can be called a coarse, inelegant Preparation, is beyond my Comprehension. Nor can I reconcile its being of very doubtful Efficacy, with its having in some Cases produced very salutary Effects, as in that of an inveterate Dysentery, which he at length transcribes. Does he know any Medicine that produces very salutary Effects in all Cases? or are all such as do not, of very doubtful Efficacy? Had the Reviewer been tolerably acquainted with medical and chymical Authors, as *Willis, Bates, Le Febure, Morton, Boerhaave, Hoffman, Hales, Burlet, Cartheuser Rieger, &c.* he might have seen, that the Physicians and Chymists of *London, &c.* have said much in praise of Lime-water, as well as those of *Edinburgh*; who, at the same time, may claim the Honour, of having made some useful Discoveries concerning its Nature and Effects. Nothing but Ignorance or Spleen can account for such like Criticisms, where-with this second Article in particular abounds, as must appear to every judicious Reader. But, for the sake of such as have not seen it, I shall give one other Instance of the Reviewer’s learned Criticisms, which adorn the same Page; where, criticizing on the second Volume of the *Edinburgh Physical Essays*,

62. “ The fourth Article on Light and Colours,” says the Critic, “ abounds with ingenious Observations; “ though we apprehend some of the Author’s Notions “ are rather *fanciful* than solid. For Example, his “ supposing that the Dew-drops upon Coleworts, and “ other Vegetables, do not really touch the Surface of “ the Plant, but hang over it by virtue of a repulsive “ Power;—that the Needle is not in Contact with “ the Water on which it swims;—that the different- “ ly-coloured Rays are projected with different Veloci- “ ties from the luminous Body;—that the Cold on “ the Tops of Mountains proceeds from the Distance

(a) *Vid. Critical Review, N° 5. Art. 2. p. 410.*

“ between those Tops and the general Surface of the Earth, &c.:” Which is all he has on this Article. Now, had this bold Critic considered, that the last Example is evident to common Sense, that the first two are Sir Isaac Newton’s Notions, and read Mons. Clairaut’s Letter to the Royal Society (a), he could scarce have had the Assurance to call at least three of them rather fanciful than solid.

63. But the Dissertations are directly attacked by a Reviewer at home, though so weakly, that I have been long in Suspense whether or not to take any Notice of it. And really, in my own Judgment, it deserves more to be despised than answered. Yet, in Deference to the Opinion of better Judges, who think my Silence may be misconstrued, I shall give the Article entire, with Annotations. It is the 5th Article of the *Edinburgh Review*, N° 2. and runs thus.

“ This is the *last* Piece in a Controversy betwixt Dr *Alston* and Dr *Whytt*, about some of the Properties and medicinal Uses of Quick-lime and Lime-water. “ It has such a Connection with the same Author’s first Dissertation, and with Dr *Whytt*’s Essay, that *no distinct Account* can be given of it separately. But we believe, that all of our Readers who attend to Subjects of this kind, have already had so much of the Dispute, that they will excuse us from reviving it; especially as we shall have a better Opportunity to entertain them on Quick-lime, when we come to consider Dr *Black*’s Experiments, which are now in the Pres.

“ We cannot however dismiss this little Piece, without taking notice of the Author’s *Candour* in acknowledging his own Mistakes. “ On reviewing the first Dissertation, I observed,” says he, “ some Passages in it which want to be *explained or corrected.*” Then follow two Pages of *Corrections* on the first Dissertation; and he writes a Preface to the second, on purpose to supply and correct some Defects and Errors

(a) *Phil. Transl.* vol. 48. p. 776.

“ which

“ which he observed in it after it was printed off: And
“ at the End of this Preface he speaks of his Antago-
“ nist in these Terms. “ I cannot conclude without
“ again owning, in Justice to the Essay, and to my
“ worthy Friend the Author, that I still esteem it *as* a
“ most useful and laborious Performance, which has
“ done more good in the Stone and Gravel, than any
“ thing formerly written on the Subject. It was the Essay
“ chiefly that determined me to drink Lime-water, as
“ well as directed to not a few of the Experiments,
“ which I made with a View to improve the Doctor’s
“ Plan, and to confirm the extensive Use of Quick-lime
“ and its Water.”

— *Hic nigrae succus lologinis, hæc est*
Ærugo mera. — *Liberius si*
Dixero quid, — *hoc mihi juris*
Cum venia dabis.

I may therefore be indulged the following Remarks.

64. That no distinct Account can be given of this little Piece separately, must argue wonderful Sincerity or Attention; since he might have found one in the second Page, where the Contents take up but about a Dozen of Lines. He has not therefore given a distinct Account of it, because he could not, but because he would not give it; chusing rather, in direct Opposition to the Intention of the Undertakers, as well as to Truth itself, to give such an Account as is much worse than none at all. And if all of the Reviewer’s Readers who attend to Subjects of this kind, think they have had enough, that is, too much, of the Dispute already; they must be bad Judges, or have little Taste either for curious or useful Knowledge. But I have Reason to think better of them, and to place this among the numerous Mistakes crowded into this short Article; which give little Ground to hope, that we shall be better entertained on Quick-lime when the Reviewer comes to consider Dr Black’s Experiments. Eighteen or nineteen Months are elapsed since they were published; and yet the Reviewer has not embraced the Opportunity. Per-

haps, on comparing them with the Dissertation, he has found no Entertainment for himself; there being no Inconsistency between them of Consequence. For whether there be any Lime in Sope-leys or not, it is agreed on both Sides, that the Acrimony of the Lixive is chiefly owing to the Change made on the alkaline Salt by the Quick-lime (a). Next,

65. The Reviewer is pleased to take notice of the Author's *Candour* in acknowledging his own Mistakes: But he corrected them also; which might have saved the Reviewer the Trouble of mentioning them; corrected Mistakes being no Mistakes, nor any Piece the worse of being corrected. Yet the Reviewer is pleased very ingenuously to multiply them: For instead of about two Pages of Corrections in the first Dissertation, there are not two Lines of Mistakes corrected; yea two Words are sufficient to correct all the observed Mistakes in them (b). For as to the first Article, it is certainly true Quick-lime, whether flaked or unflaked, destroys all Acids; and also that it makes Ebullition, or effervesces with Oil of Vitriol, Spirit of Nitre, and Spirit of Salt; that is, with all the strong Acids, the weaker only being sometimes absorbed without Ebullition. So inserting the single Word *strong* before *Acids* makes all the Correction designed. The second Article is owing to the Regard due to the Experiment of a very great Man. The third is a new Discovery; and all the three rather explicative than corrective. The fourth Article contains Experiments, but no Corrections, though it takes up three half Pages. And inserting the Word *bitter* before Sea-salt, corrects the Mistake on the last Article. I would willingly believe, that the Reviewer never read these two Pages, as the only Excuse so gross a Misrepresentation of Facts is capable of, were it not that his Words discover the Design: For after quoting from the second Dissertation, that some Passages in the first wanted to be *explained or corrected*, he very candidly adds, "Then follow two Pages of Corrections on the first

(a) *Vid. Diff. 1. p. 17. № 4. et supra, № 15.*

(b) *Vid. Diff. 2. p. 62.*

"Dissertation;" taking no notice of the *Explications*, of which they almost entirely consist. With the same Ingenuity he brings in the Preface to the second Dissertation, as if it were full of Errors: Whereas,

In that Preface there is only one Mistake corrected, which the single Word *dele* might have done. But it being more instructive plainly to account for the Mistake, and to give the Experiments correcting it, with their Use, Half a Page is thus employed. As for the other three Pages of the Preface, they are left to the Reviewer's Correction; and I believe he will acquit them, if not on account of the Diversion they must give him, when he is about to entertain us on Quick-lime; at least for the sake of the Conclusion, the greatest Part whereof, though quite foreign to the Subject of the Dissertation, he has *verbatim* transcribed, throwing in only a monosyllable Conjunction, where it was not wanted, and no doubt would willingly make it pass for a Palinodia. But,

66. All the Author designed by it was to show, that however much he might differ in some Things from his worthy Friend, yet he was by no means blind to his Merits. An Essay may be signally useful, though not absolutely perfect; yea Mistakes have many times been the Occasion of very beneficial Discoveries. It was a Mistake that discovered the Virtues of Lime-water in an epidemical Fever (*a*); and the now so common Use of it in the Stone and Gravel, and consequently the ascertaining the Good it does in these Diseases, is owing perhaps more to a Mistake in the Essay, than any Truth therein contained. For though Dr *Hales* proved by Experiments the lithontriptic Power of Lime-water, and the Experiments, with *David Millar's* Case, in the Essay notably confirmed it; yet the Time it takes to produce any Effect, the Pain and Uneasiness sometimes accompanying the Use of it, and the little Success often attending it, could not but be very discouraging. But when it came to be generally believed, that the

(*a*) *Vid. Diff. I. p. 75.*

Stone-breaking Virtue of Shell-lime Water was near three times greater than that of Stone-lime Water, and also that it was, by far, the safest of the two; I know no Fact could so effectually determine every nephritic Person, to have Recourse to it as a divine Remedy. And I am credibly informed, that there has been more Lime-water made use of in *London* and *Edinburgh*, in one Year, not long after the Publication of the *Essay*, than in almost Half the Century preceding. But if this Mistake be discovered, and Stone-lime Water found to be as efficacious and safe, in every Disease, as Shell-lime Water, especially if on other Accounts preferable; can the Reviewer say that it ought not to be corrected, or that so useful a Truth ought, on any account, to be concealed? Yea allowing it to be doubtful on which Side the Truth lies, can there be a more effectual Way taken to discover it, than by making the Arguments on both Sides public? Besides, it was this, and such like Mistakes, whether real or imaginary, which led to the Experiments, whereby not a few curious, as well as useful Truths, were brought to Light, which otherwise probably had never appeared. Such Controversies therefore, or Disputes, contributing to mutual Improvement, inciting to Diligence in the Advancement of Science, and of the public Welfare, and altogether consistent with the sincerest Friendship, never were, nor will be discouraged by any Lover of Learning.

F I N I S H E S.

CORRIGENDA in the NOTES.

Pag. lin.

9. 2. for 54. read 59.

Ibid. ult. after *Diss.* add 1.

10. 1. for p. read N^o.

21. ult. for 33. read 63.

